

NATURAL HISTORY OF PLUMMERS ISLAND, MARYLAND.  
XXIV. BITING MIDGES (DIPTERA: CERATOPOGONIDAE)  
2. THE SPECIES OF THE TRIBES HETEROMYIINI  
AND SPHAEROMIINI

Willis W. Wirth and William L. Grogan, Jr.

*Abstract.*—A short review is made of the published biological information on the adults and immature stages of the predaceous midge tribes Heteromyiini and Sphaeromiini. In both tribes the larvae are aquatic and are most characteristic of the margins and shallow waters of lakes, ponds, and large and small streams. Adult females prey on small Diptera, usually chironomid midges and even the males of their own species, which they usually capture in the male swarms. Diagnoses are presented of all taxa, tribes, genera, and species; and keys are given for identification of the species of the lower Potomac Valley. Seventeen species belonging to eight genera are found in the study area, including one species described as new: *Sphaeromyias bifidus*, n. sp.

---

### I. Introduction

The first paper of this series (Wirth, Ratanaworabhan, and Messersmith, 1977) provided a short review of the anatomy, systematics and biology of the biting midges of the family Ceratopogonidae, and a key for the identification of the North American genera. As the series continues, keys and descriptions will be given for the species occurring in the lower Potomac River valley in the Maryland and Virginia counties immediately adjacent to Plummers Island and the District of Columbia. Discussion of taxonomic characters and explanation of our terminology was given in our first contribution. Although it would be desirable to treat the Potomac Valley species in phylogenetic sequence, some difficult groups scattered through the sequence require additional collection and study, and we have been forced to delay their study until later in the series. For the present study we have selected two tribes of Ceratopogoninae for which collections have been more adequate and the taxonomy is more advanced. The North American Sphaeromiini were studied in some detail by Wirth (1962a), and several genera of Sphaeromiini and Heteromyiini have recently been revised by Grogan and Wirth (1975, *Clinohelea*; 1977, *Jenkinshalea*) and Wirth and Grogan (1977, *Heteromyia*).

## II. Biology and Immature Stages of the Tribes Heteromyiini and Sphaeromiini

Only a limited amount of information is available on the habits and life histories of the midges of the tribes Heteromyiini and Sphaeromiini. So far as known, the adult females are predaceous on chironomid midges and other smaller, soft-bodied insects. Observations of this habit were reported by Staeger (1839), who stated that the females of all the Ceratopogonidae (the old genus *Ceratopogon*, as he knew it) were predaceous. Staeger's statement was much too sweeping but showed that he must have made many observations on the habit. Walker (1856b) noted that "The species whose femora are armed with spines make a prey of other small insects, which they pierce with their sharp proboscis," a statement as much too conservative as Staeger's was too broad.

Loew (1864) noted that females of *Macropeza albitarsis* Meigen preyed on other small insects along streams during the day and in the evening hours could be found in large numbers with the males, held in copulation by the females so tightly that they could not be separated with a forceps and when one pinned the females, the males remained attached and died thus.

Published prey records for the predaceous Ceratopogoninae are few, and apparently nothing more was written until Malloch (1914) noted that he had seen a large species of *Palpomyia* feeding on a perlid stonefly in Britain. Edwards (1920) was the first to devote full attention to recording the prey species of the predaceous Ceratopogoninae, and (1923) listed prey of the following genera (nomenclature brought up to date): *Ceratopogon*, *Isohelea*, *Serromyia*, *Stilobezzia*, *Bezzia*, *Palpomyia*, *Mallochohelea*, and *Macropeza*. Only the last two genera fall in the tribes Heteromyiini and Sphaeromiini.

Gad (1951) gave an excellent comprehensive account of the morphology of the head capsule and mouthparts of the family Ceratopogonidae and reviewed the adult feeding habits in detail. The new prey records he gave were for the genus *Serromyia* in the tribe Stilobezziini. As a typical representative of the predaceous ceratopogonids, he chose to illustrate and describe the head and mouthparts of *Probezzia seminigra* (Panzer) (as *Dicrobezzia venusta* (Meigen)). In this group the mandibles are broad blades with unusually large teeth, but the laciniae, though still present, are reduced. All mouthparts are present in the male, but the armature is reduced.

The adult feeding habits of the predaceous ceratopogonids were summarized by Downes (1960): "The females of insectivorous Ceratopogoninae (typical genera: *Ceratopogon*, *Stilobezzia*, *Clinohelea*, *Palpomyia*) feed on small insects that are captured in flight. The prey is almost always the male of species of Nematocera and Ephemeroptera, and it is frequently, and

probably typically, captured in the male swarms (mating swarms) that are so often produced in these groups. Such swarms are formed near, and are controlled by, visible landmarks. At least in many genera the prey of the female also includes the male of her own species, captured in the specific male swarms; under these circumstances, capture of the male by the female, as prey and capture of the female by the male, as mate, take place simultaneously. During mating the female pierces the male through the head and injects salivary enzymes; the male is ultimately reduced to a brittle cuticle that breaks away except for the terminalia, which may adhere for some time. The female, as in other Nematocera of less dramatic feeding habits, finds the specific mating swarm probably by responding to the same landmarks as do the males. But whereas, e.g., *Culicoides* [sic] hunts for its food by quite other means, these insectivorous females hunt by responding to landmarks of the kind that are used also and originally in connection with mating. They thus reach, perhaps almost indifferently, the male swarm of their own or another species and proceed to capture prey." Downes (1978) published a detailed summary and elaboration of his earlier studies on the feeding and mating habits of the insectivorous Ceratopogoninae. The photograph showing the female *Probezzia concinna* (Meigen) feeding on her mate during copulation appearing in Downes' papers (1971, 1978) was kindly furnished by Dr. Downes and is reproduced in Fig. 1.

*Egg.*—The oviposition of *Johannsenomyia argentata* (Loew) was reported by Johannsen (1905) and Thomsen (1937) from observations made at Ithaca, New York. The eggs are deposited in more or less spiral bands 30 to 40 mm in length by females hovering several inches above the water surface in sheltered places near the shore of the pond habitats. "With the head pointing toward the shore and the body swaying rhythmically to and fro, the egg-laying begins. The eggs are enclosed in a gelatinous ribbon, placed at right angles to the long axis. . . . The lateral swaying of the body at the beginning of the egg-laying is of about one inch amplitude, but as the ribbon of eggs increases, the amplitude decreases until just before deposition it is less than  $\frac{1}{2}$  inch. When the egg string is about  $\frac{1}{4}$  inch long the fly seizes it with her hind and middle legs, the hind legs guiding, the middle legs paying out the string as its length increases. The fore legs are folded up under the body. This egg-laying process occupies from three to five minutes; when completed the fly suddenly darts down to the water's surface, deposits her eggs and flies away. The eggs when first laid are whitish, but later, as development progresses, they become brown. Each egg is about 0.4 mm in length by 0.07 in width; somewhat pointed at one end and flattened at the other, the latter with a minute rectangular bolster with knobbed corners" (Johannsen, 1905). Hamm (1919) and Wesenberg-



Fig. 1. *Probessia concinna*: simultaneous feeding (female, left) and mating (after Downes, 1971).

Lund (1943) described similar habits for *Mallochohelea nitida* (Macquart) and *Probessia concinna* (Meigen) respectively, in Europe.

*Larva*.—Larvae of all Ceratopogoninae with rare exceptions swim or crawl with snakelike side to side undulations. The speed of movement usually is characteristic of the genus. The following diagnosis is taken mostly from Glukhova (1971).

Larvae vermiform, lacking prolegs, mostly aquatic. Head prognathous; head capsule well developed, narrower at anterior end, broader at posterior third, convex on dorsal side; ventral side flattened. Frontal plate, located

between the arms of the epicranial suture, not delineated on anterior half of head (characteristic of tribes Heteromyiini, Sphaeromiini, and Palpomyiini). Head capsule with five pairs of sensory pits and 13 pairs of setae, the arrangement of which is diagnostic. They are homologous throughout the family and given letter designations as shown in Figs. 9, 14 and 20. Antenna 3-segmented, with small papilla on second segment. Mandible elongate and curved, pointed distally and bearing a small tooth at about midlength. Maxilla with parts fused in a single, weakly sclerotized lobe located to side and below mouth opening; a small maxillary palpus with small sensory papilla present. Labium sunken into oral cavity, anterior margin of ventral wall of head capsule comprising the hypostomium with free margin often denticulate. Pharyngeal apparatus consisting of a hypopharynx and epipharynx. A conical membranous hypopharynx extending forward and downward toward the labium. Epipharynx lying in a depression formed by the broadened part of the epipharynx; consisting of two lateral arms and a central portion bearing several combs with characteristic arrangement of denticles.

Body with 12 elongate and subcylindrical segments, usually similar in size and shape and about the same width as head. Thoracic segments little broader than abdomen except before pupation. Anal segment usually longer than the others, narrower and rounded caudad; bearing caudally a series of small or long hairs of characteristic shape and position. Anal papillae more or less protrusible within or outside the body; comprising two processes, each with four lobes. Body pigmentation may occur in the inner fat body.

*Pupa*.—Pupa of characteristic ceratopogonine shape (see part 1 of this series). Respiratory horn clavate; length variable from short to only moderately long; numerous spiracles borne in a row at apex. Abdominal segments 3–7 similarly bristled, the arrangement of tubercles and setae quite constant for each genus, but the degree of development with specific differences. In the Sphaeromiini the pupae of a number of genera bear membranous glandular discs on the venter of several abdominal segments. Anal segment with a bristle-bearing tubercle and with well-developed, usually long and tapering, apicolateral processes. Operculum with one or more pairs of setae or tubercles.

*Larval biology*.—The larvae are usually found in greatest frequency and abundance at the margins of larger ponds, lakes, and streams. Krivosheina (1957) found the early stages of *Probezzia*, *Mallochohelea*, and *Sphaeromias* in the surface layer of sand along the banks of larger rivers and their tributaries. She found larvae of *Sphaeromias* also abundant in natural bodies of water without vegetation situated close to cattle pens in pastures.

There are few data available on the food preferences of the larvae of Heteromyiini and Sphaeromiini but those that have been published indicate that the larvae are predaceous, feeding on any small animals of the appropriate size found in the larval habitat. Dendy (1973) found ceratopogonid larvae (presumably including representatives of these tribes) preying on egg masses and newly hatched larvae of Chironomidae in Alabama. Weerekoon (1953) was of the opinion that the red substance found in the gut of *Probezzia venusta* and *Johannsenomyia* sp. (? *nitida*) in Loch Lomond in Scotland could only be hemoglobin from the larvae of *Chironomus* bloodworms that they had fed upon. He described the manner of feeding of the larvae of *Palpomyia quadrispinosa* Goetghebuer, a species with habits similar to those of the tribes under discussion here.

Williams (1955) found a large concentration of pupae of *Probezzia williamsi* Wirth (reported as *P. sabroskyi* Wirth) on the beach at the Douglas Lake, Michigan, Biological Station. Apparently they had migrated from an area 30–40 feet out in the lake where a clump of submerged pondweed (*Potamogeton natans* L.) broke the surface. The exposed leaves of the pondweed were covered with ceratopogonid egg masses, which unfortunately could not be identified to genus; the larvae that hatched from the masses perished before they could be reared to pupation. Presumably the egg masses were mainly if not entirely those of *P. williamsi*, and the larval habitat was in this area of the lake. Further ecological association of *P. williamsi* with the pondweed could not be demonstrated.

Williams also reported an aggregation of sphaeromiine pupae in a sand spit beach pool at Sedge Point in Douglas Lake. A few cat-tails (*Typha latifolia* L.) were growing in the shallow water of the lake side of the sand spit and many grew in the shallow water (10 inches or less) in the adjacent pool. Many sphaeromiine pupae were found attached to the cat-tails on the lake side of the spit, but none was found on those growing in the pool. From this it was concluded that the larvae of these species lived in the lake itself rather than in the beach pool. Most of the pupae were attached to the leaves within six inches of the water surface although some had crawled a foot or more up the leaf shaft. The pupae themselves were very active when disturbed and could make their way along the leaf with the aid of sticky, transparent pads on the venter of some of the abdominal segments and spines on the body wall. The presence of larval skins on the cat-tail leaves indicated that the larvae had migrated up the stems and onto the leaves where they pupated. In most cases the pupae had migrated farther. Adults of four species were reared from the pupae: *Probezzia williamsi* Wirth, *P. atriventrtris* Wirth, *Jenkinshalea albaria* (Coquillett), and *Mallochohelea halteralis* (Malloch) (nomenclature brought up to date). The ceratopogonids were not found associated with sedges in the lake, and it was not

determined whether the association with the cat-tails was fortuitous, and the normal place of pupation might possibly be the sandy beach itself.

### III. Special Habitats on Plummers Island and Vicinity

Two excellent larval habitats yielding an unusual concentration of sphaeromiine species in the Plummers Island study area warrant further discussion.

The first location was the sandy margin of the Potomac River just upstream from Plummers Island at the mouth of Scott Run in Fairfax County, Virginia. Here a small peninsula juts downstream into the river, leaving a small sand bar with a quiet leeward pool on the landward side. Fig. 21 shows a similar habitat on the north bank of the Potomac River at the lower end of Plummers Island. On 4 and 7 June 1955, Wirth and Jones found a heavy concentration of ceratopogonid pupae in the damp sand on the beach from six to 12 inches above the water level and from six inches to as much as six feet horizontally from the water's edge. There was no vegetation on this beach or in the shallow water nearby, although there was an abundant growth of buttonbush (*Cephalanthus* sp.) several hundred yards away in the river where the stream forms a series of rock-strewn rapids. Six species of Ceratopogoninae were reared from pupae collected on this beach, isolated in glass vials, and brought into the laboratory: *Jenkinshalea albaria* (Coquillett) (extremely abundant), *Johannsenomyia argentata* (Loew), *Probezzia albitibia* Wirth, *P. pallida* Malloch, and *P. smithii* (Coquillett) (all Sphaeromiini), and *Palpomyia subaspera* (Coquillett) (Palpomyiini). Three larvae of *J. albaria* were isolated from samples of the beach sand.

The second habitat was a freshwater pond at the Patuxent Wildlife Research Center near Laurel in Prince George's County, Maryland, known as Knowles Marsh no. 1 (Fig. 22). Dominant vegetation along the margins of this pond included cat-tails, primrose, willows, and several species of grasses. The pond also supported a fairly large growth of white (*Nymphaea*) and yellow (*Nuphar*) water lilies. Growing along the margins and in the pond was a common water plant, marsh purslane, *Ludwigia palustris* (L.) Elliott, a member of the family Onagraceae. Where this species grew in the water, it was covered with algae (*Spirogyra*), thus providing a perfect habitat for ceratopogonid larvae. Numerous larvae and pupae of *Mallochelea atripes* Wirth were isolated from the algae-covered purslane in Berlese funnels, and then reared to adults in cotton-stoppered vials. The larvae of this species were extremely active and swam near the surface of the water in which they were recovered. A female of *Sphaeromias longipennis* (Loew) was also reared from a pupa from this habitat. The following other ceratopogonid genera were also reared from larvae and pupae from this habitat: *Alluaudomyia*, one species; *Bezzia*, two species; *Dasyhelea*, one species; *Palpomyia*, one species; *Stilobezzia*, one species.

#### IV. Systematic List of the Heteromyiini and Sphaeromiini of Plummors Island and Vicinity

- |   |   |
|---|---|
| <p>Tribe Heteromyiini</p> <p>Genus <i>Clinohelea</i> Kieffer</p> <p>1. <i>bimaculata</i> (Loew)</p> <p>2. <i>curriei</i> (Coquillett)</p> <p>3. <i>pseudonubifera</i> Grogan and Wirth</p> <p>Genus <i>Heteromyia</i> Say</p> <p>4. <i>fasciata</i> Say</p> <p>5. <i>prattii</i> Coquillett</p> <p>Genus <i>Neurohelea</i> Kieffer</p> <p>6. <i>nigra</i> Wirth</p> <p>Tribe Sphaeromiini</p> <p>Genus <i>Jenkinshelea</i> Macfie</p> <p>7. <i>albaria</i> (Coquillett)</p> | <p>Genus <i>Johannsenomyia</i> Malloch</p> <p>8. <i>argentata</i> (Loew)</p> <p>Genus <i>Mallochohelea</i> Wirth</p> <p>9. <i>albibasis</i> (Malloch)</p> <p>10. <i>albihalter</i> Wirth</p> <p>11. <i>atripes</i> Wirth</p> <p>Genus <i>Probezzia</i> Kieffer</p> <p>12. <i>albitibia</i> Wirth</p> <p>13. <i>pallida</i> Malloch</p> <p>14. <i>smithii</i> (Coquillett)</p> <p>15. <i>xanthogaster</i> (Kieffer)</p> <p>Genus <i>Sphaeromias</i> Curtis</p> <p>16. <i>bifidus</i>, new species</p> <p>17. <i>longipennis</i> (Loew)</p> |
|---|---|

#### V. Diagnoses of Species and Biological Notes

##### Tribe HETEROMYIINI Wirth

*References.*—Wirth, 1962a (diagnosis; key to genera); Debenham, 1974 (diagnosis; revision of Australia and New Guinea species); Wirth, Ratana-worabhan, and Blanton, 1974 (included genera; key)

*Diagnosis.*—Large, nearly bare, predaceous species. Antenna usually elongate; segments cylindrical in female (Fig. 2a). Palpus slender, five-segmented. Female mandible (Fig. 2c) with 7–10 coarse teeth. Mesonotum often with prominent anteromedian spine or tubercle. Legs (Fig. 2d) long, usually slender; femora often somewhat swollen distally, armed or unarmed; fourth tarsomere cordiform, prolonged in bifid spinose lobes or greatly elongated on hind legs; fifth tarsomere not armed with ventral spines or batonnets, that of fore leg often inflated, fusiform. Claws of female usually unequal, at least on hind leg, or a single claw with basal tooth. Wing without macrotrichia, often fasciate or infuscated; medial fork barely to broadly sessile; one or two radial cells; costa extending to more than 0.7 of wing length. Female abdomen (Fig. 2e) without eversible glands or sclerotized internal gland rods, often petiolate. Two large sclerotized spermathecae usually present. Male genitalia (Fig. 2f) usually long and slender; basistyle simple; dististyle long and slender; aedeagus simple, with basal arch low or high, distal portion short; parameres separate, slender, distal blades usually clavate.



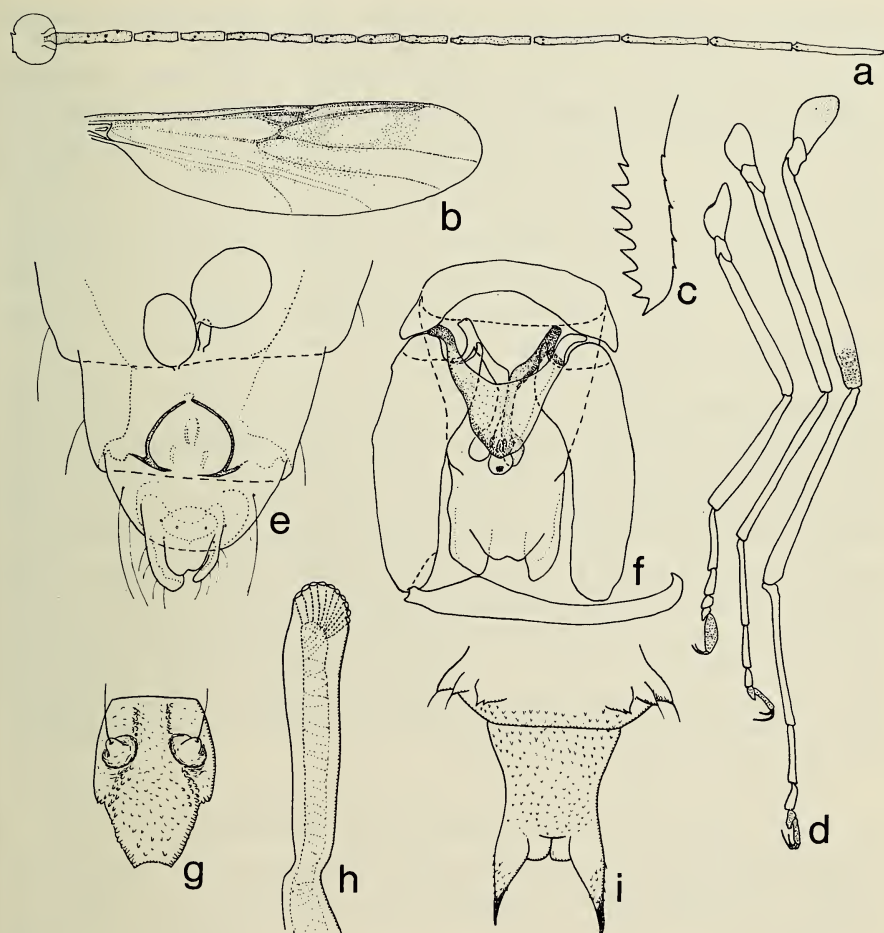


Fig. 2. *Clinohelea bimaculata*: a–e, female, f, male genitalia; g–i, pupa; a, antenna; b, wing; c, mandible; d, leg pattern; e, genitalia; g, operculum; h, respiratory horn; i, terminal segment.

*Immature stages*.—Larval head with lateral arms of epicranial suture obsolescent on anterior half of head, thus resembling larvae of the tribes Sphaeromiini and Palpomyiini. In the Ceratopogonini and Stilobezziini the lateral arms of the epicranial suture are complete to the bases of the antennae. Pupa without ventral membranous discs on abdominal segments.

#### Genus *Clinohelea* Kieffer

*Clinohelea* Kieffer, 1917:295. Type-species, *Ceratopogon variegatus* Winternertz, by original designation.

*References.*—Wirth, 1951b:321 (description and figures of pupa; Grogan and Wirth, 1975:275 (revision of North American species).

*Diagnosis.*—Moderately large, shining midges, usually with infuscated wing pattern. Antenna (Figs. 2a, 3a, 4a) elongate, segments slender and cylindrical. Fourth tarsomere of at least middle and hind legs deeply bilobed, each lobe ending in a stout blunt spine and smaller spines; front fifth tarsomere greatly inflated in both sexes (Fig. 2d), often bicolored (Figs. 3b, 4b); front claws equal, middle and hind claws very unequal in female; all claws equal in male; two radial cells present (Fig. 2b); aedeagus (Figs. 4e–g) with low anterior arch, distal portion broad, underlying membrane extending beyond tip; parameres (Fig. 2f) usually divided, each portion slender with an elongated bulbous tip.

*Immature stages.*—Larvae are aquatic; swimming. Glukhova (1977) figured the head, pharyngeal apparatus, and last two segments of the larva of the palaearctic species *C. unimaculata* (Macquart). Larval mandibles of this species especially long and slender, about a third as long as head; antenna short; labrum with one pair of long setiform sensilla; head hairs *o*, *q*, and *u* long and multiple; *p*, *s*, *t*, *w*, and *y* hairs long and single; pitlike sensilla *j*, *k*, *m*, *n*, *r*, and *z* present; epipharynx with two pairs of well-developed combs and lateral arms each with a comb of about ten strong teeth; anal segment and preanal segments subequal in length, the former with four long and two short perianal hairs. Pupae of *C. bimaculata* (Loew) were described by Wirth (1951b) and Grogan and Wirth (1975); see diagnosis under this species below.

#### Key to Potomac Valley Species of *Clinohelea*

1. Fifth tarsomere of front leg solid brown (Fig. 2d); wing with two spots, one centered over first radial cell, second near tip of costa (Fig. 2b) *bimaculata* (Loew)
- Fifth tarsomere of front leg with pale band (Figs. 3b, 4b); wing with one spot centered over first radial cell or entirely infuscated (Figs. 3d, 4c) 2
2. Fifth tarsomere of front leg with pale band twice as long as width of tarsomere (Fig. 3b) *curriei* (Coquillett)
- Fifth tarsomere of front leg with pale band much shorter than width of tarsomere (Fig. 4b) *pseudonubifera* Grogan and Wirth

#### 1. *Clinohelea bimaculata* (Loew) (Figs. 2, 4f)

*Ceratopogon bimaculatus* Loew, 1861:311 (female; Washington, D.C.).  
*Johannseniella bimaculata* (Loew); Malloch, 1914:227 (combination; re-description).

*Johannsenomyia bimaculata* (Loew); Malloch, 1915a:333 (combination; key).

*Clinohelea bimaculata* (Loew); Kieffer, 1917:317 (combination; key; fig. tarsus; Wirth, 1951a:321 (pupa described, figured); Johannsen, 1952:164 (key; fig. tarsus); Wirth, 1965:136 (distribution); Grogan and Wirth, 1975:281 (male, female, pupa redescribed; figs.).

*Female diagnosis*.—Wing 1.65–2.68 mm long; with two infuscated areas, one centered over first radial cell, the second at tip of costa (Fig. 2b). Legs (Fig. 2d) mainly yellow, hind femur with dark subapical band; fifth tarsomere on front leg solid brown. Genitalia as in Fig. 2e.

*Male*.—Much smaller, but similar to female; genitalia (Fig. 2f) with breadth of aedeagus (Fig. 4f) subequal to its length.

*Immature stages*.—Larva unknown. Pupa: Length 3.5 mm; color pale brown. Operculum (Fig. 2g) narrow, 0.8 times as broad as long with a pair of rounded tubercles each bearing a long seta; surface with fine tubercles, those on lateral margin sharp and setose. Respiratory horn (Fig. 2h) moderately long and slender, about five times longer than broad with ten apical spiracles. Anal segment (Fig. 2i) about twice as long as broad; surface covered with fine tubercles; apicolateral processes about a third of total length of segment, with subapical fine tubercles; tips heavily sclerotized and sharply pointed, directed caudad.

*Biology*.—Wirth (1951a) reared this species from the margin of a small stream in Virginia. This species is a common inhabitant of wooded, swampy situations.

*Distribution*.—Michigan and Texas to New Hampshire and Florida.

*Potomac Valley records*.—D.C.: Washington, vi. (Coquillett), 3 females. MARYLAND: Montgomery Co., Glen Echo, vii, viii, 1922, 1923 (Malloch), 4 females. Prince George's Co., Beltsville, v.1922 (Malloch), 1 female; Patuxent Wildlife Res. Ctr., v–viii, 1975 (Grogan, malaise trap), many males, females. VIRGINIA: Alexandria, vii, 1951, 1952 (Wirth), 3 females; Alexandria, Dyke Marsh, vi.1952 (Wirth), 7 males, 24 females. Fairfax Co., Falls Church, vi,vii.1950, 1951, reared from stream margin (Wirth), 21 males, 36 females, some with pupae.

## 2. *Clinohelea curriei* (Coquillett)

(Figs. 3, 4g)

*Ceratopogon curriei* Coquillett, 1905:62 (female; British Columbia).

*Palpomyia curriei* (Coquillett); Malloch, 1914:219 (combination; description).

*Clinohelea curriei* (Coquillett); Johannsen, 1943:783 (combination; Wirth, 1965:136 (distribution); Grogan and Wirth, 1975:277 (redescribed; figs.; distribution; synonym: *nebulosa*).

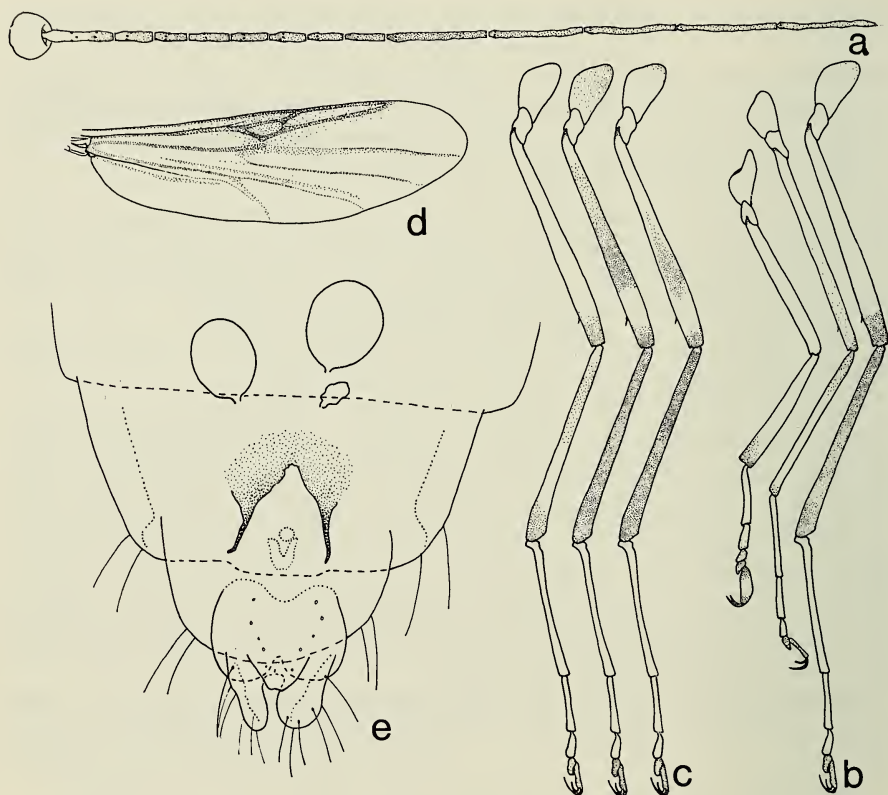


Fig. 3. *Clinohalea curriei*, female: a, antenna; b, leg pattern; c, variation in hind leg pattern; d, wing; e, genitalia.

*Palpomyia nebulosa* Malloch, 1915a:322 (female; Michigan).

*Clinohalea nebulosa* (Malloch); Johannsen, 1943:783 (combination); Wirth, 1965:136 (distribution).

*Female diagnosis*.—Wing 2.53–3.32 mm long; with one large infuscated area centered over first radial cell or entirely infuscated (Fig. 3d). Legs (Fig. 3b) yellowish, apex of front tibia and middle femerotibial area brownish, hind leg (Fig. 3c) usually with tibia and distal sixth of femur brown, occasionally femur also broadly brownish in midportion; fifth tarsomere of front leg brown with conspicuous median pale band twice as long as width of tarsomere. Genitalia as in Fig. 3e.

*Male*.—Smaller than female; genitalia similar to those of *C. bimaculata*; aedeagus as in Fig. 4g.

*Immature stages*.—Unknown.

*Biology*.—This species inhabits swampy habitats and is often found with *C. bimaculata*, although usually not as common.

*Distribution*.—Alaska and California to Newfoundland and Florida.

*Potomac Valley records*.—MARYLAND: Prince George's Co., Patuxent Wildlife Res. Ctr., v-viii.1975, malaise trap (Grogan), 2 females. VIRGINIA: Alexandria, vi.1952 (Wirth), 11 females; Alexandria, Dyke Marsh, 31.v.1954 (Wirth), 3 males, 5 females. Fairfax Co., Dead Run, 18.vi.1914 (Shannon), 1 female.

### 3. *Clinohelea pseudonubifera* Grogan and Wirth (Figs. 4a-e)

*Clinohelea* sp. 1; Wirth, 1951a:321 (females; Virginia).

*Clinohelea pseudonubifera* Grogan and Wirth, 1975:280 (male, female; Maryland; figs.).

*Female diagnosis*.—Wing 2.03 mm long; with one large infuscated area centered over first radial cell (Fig. 4c). Legs (Fig. 4b) yellow; hind tibia, distal five-sixths of hind femur, and distal fifth of middle femur and all of middle and hind tibiae brown; fifth tarsomere of front leg brown with very short median pale band. Spermathecae as in Fig. 4d.

*Male*.—Smaller, but similar to female; genitalia similar to those of *C. bimaculata*; aedeagus as in Fig. 4e.

*Immature stages*.—Unknown.

*Biology*.—Nothing is presently known of the biology of this apparently uncommon species, known only from the original type series.

*Distribution*.—Ontario to North Carolina.

*Potomac Valley records*.—VIRGINIA: Fairfax Co., Falls Church, 4.vii.1950 (Wirth), 2 females.

### Genus *Heteromyia* Say

*Heteromyia* Say, 1825: plate 35. Type species, *Heteromyia fasciata* Say, by monotypy.

*Pachyleptus* Walker, 1856a:426. Type-species, *Pachyleptus fasciatus* Walker, by monotypy.

*References*.—Duret and Lane, 1955:35 (revision, key to Neotropical species); Wirth and Grogan, 1977b:177 (revision of North American species; new Neotropical species).

*Diagnosis*.—Large species with fasciate wings (Fig. 5g); front leg with femur short and greatly swollen, with conspicuous armature of 20–30 stout black spines, the tibia arcuate (Fig. 5a); claws of anterior four legs of

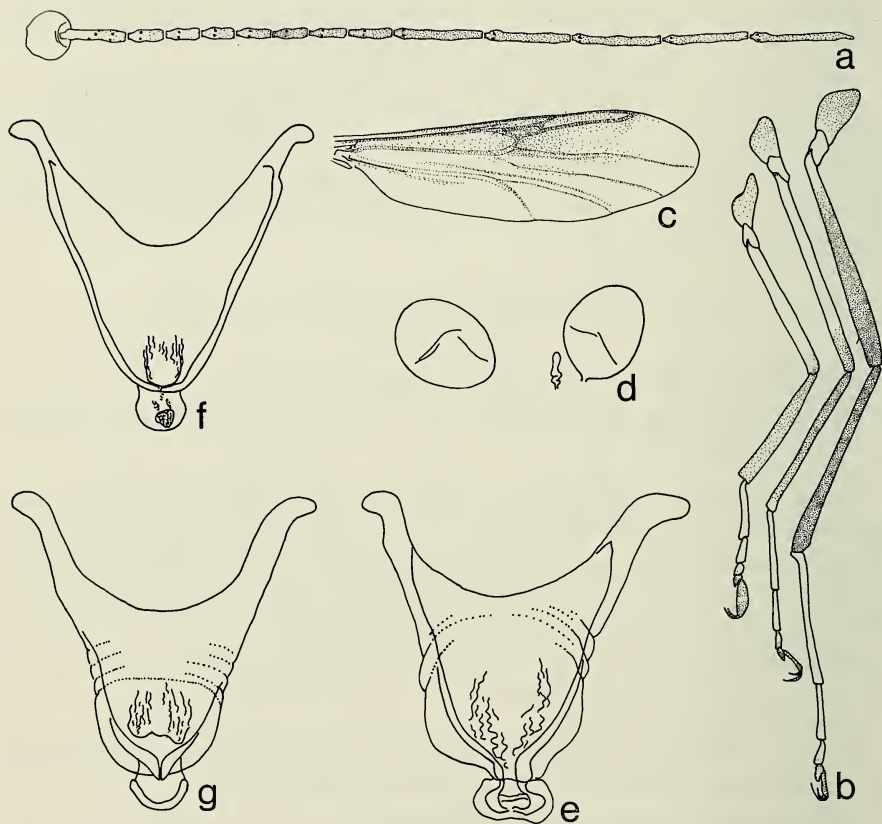


Fig. 4. *Clinohoelea* spp.: a-e, *C. pseudonubifera*; f, *C. bimaculata*; g, *C. curriei*; a, female antenna; b, female leg pattern; c, wing; d, spermathecae; e-g, male aedeagi.

female short and equal with basal inner teeth; hind leg of female with a single long claw with short basal barb (Fig. 5h); claws of male small, equal; aedeagus (Fig. 5e) with short basal arch and broad distal body; parameres (Fig. 5f) separate, apices slender and clavate.

*Immature stages.*—Larva unknown. Pupa with respiratory horn sub-cylindrical, about six times as long as broad, with 12 spiracles borne at the apex which is not expanded (Fig. 6b); segmental spines of abdomen moderately strong and sharp, suberect; apicolateral processes (Fig. 6c, d) of abdomen quite long and tapering, sharp pointed, directed caudad, and bearing appressed spinulose vestiture.

*Biology.*—The larva are found in aquatic or semi-aquatic vegetation; rearings have been made from *Sphagnum* and *Cabomba*.

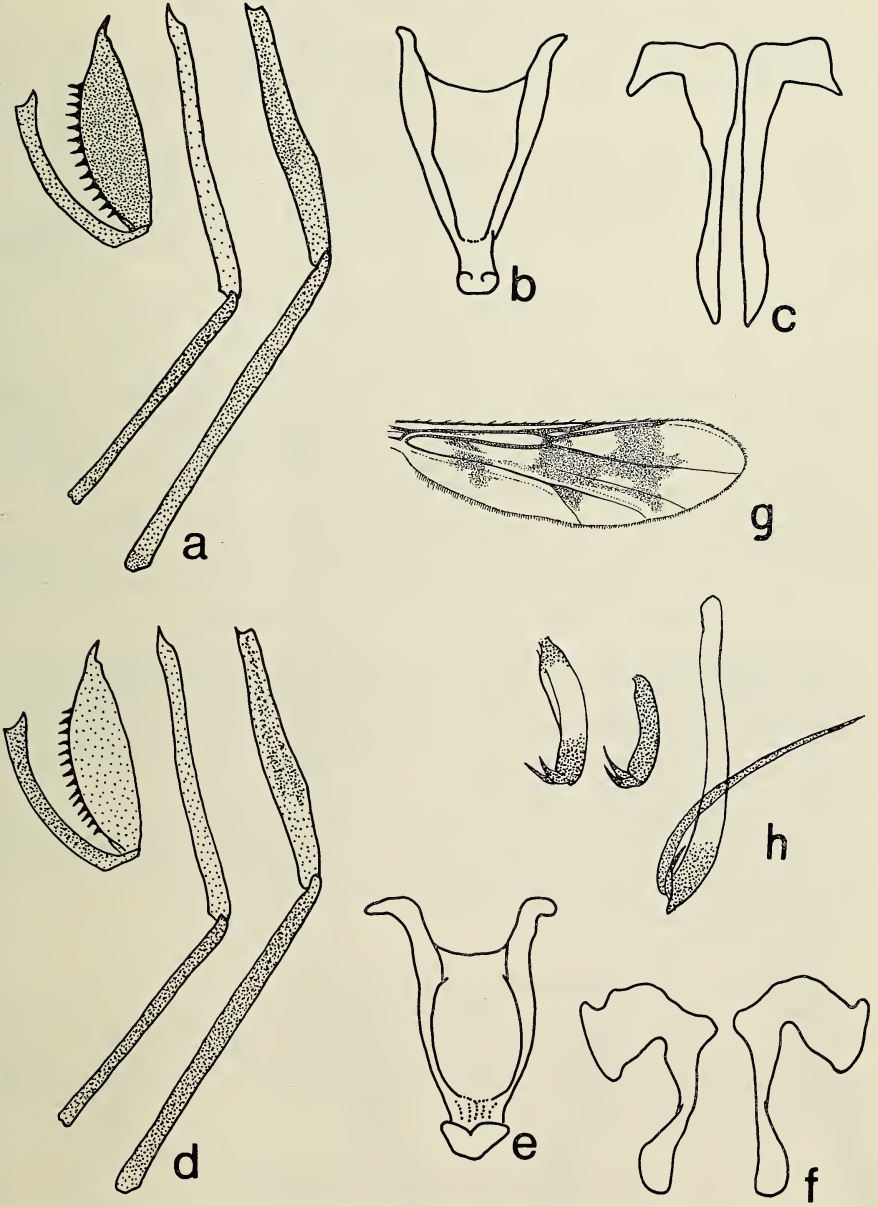


Fig. 5. *Heteromyia* spp.: a-c, g-h, *H. fasciata*; d-f, *H. prattii*; a, d, female leg pattern; b, e, male aedeagi; c, f, male parameres; g, wing; h, fifth tarsomeres and claws of female.

Key to Potomac Valley Species of *Heteromyia*

1. Abdomen with dense whitish pruinescence dorsally; mid and hind femora yellowish brown, rarely with faint subapical infuscation  
*fasciata* Say
- Abdomen without whitish pruinescence dorsally, but marked with conspicuous segmental pale and dark bands; mid and hind femora with variable but usually extensive infuscation except at apices  
*prattii* Coquillett

4. *Heteromyia fasciata* Say  
 (Fig. 5)

*Heteromyia fasciata* Say, 1825: plate 35 (no type locality; “of rather frequent occurrence”); Malloch, 1915a:360 (key); Kieffer, 1917:325 (key); Johannsen, 1943:783 (list); Johannsen, 1952:163 (figs.; key); Wirth, 1965:137 distribution; synonyms: *festiva*, *pratti*).

*Ceratopogon festivus* Loew, 1861:314 (male, female; Pennsylvania).

*Heteromyia festiva* (Loew); Malloch, 1915a:360 (combination; key); Kieffer, 1917:325 (key); Johannsen, 1943:783 (list); Johannsen, 1952:163 (key; variety of *fasciata*); Wirth, 1965:137 (synonym of *fasciata*).

*Female diagnosis*.—Wing length 2.71–3.49 mm. A large subshining species with brown legs, yellow on middle femur and distal third of hind femur (Fig. 5a); dorsum of abdomen with whitish pruinosity; wing fasciate (Fig. 5g); front and middle claws small and equal, hind claw greatly elongated with a smaller inner claw (Fig. 5h).

*Male*.—Similar to female but smaller and slightly darker; aedeagus (Fig. 5b) with narrow tip; parameres (Fig. 5c) with slender, slightly swollen distal portions and short, slightly expanded basal arms.

*Immature stages*.—Unknown.

*Biology*.—Unknown.

*Distribution*.—Massachusetts south to Florida.

*Potomac Valley records*.—MARYLAND: Indian Head, 28.vi.1932 (Bishop), 1 female. VIRGINIA: Alexandria, vi–vii.1952 (Wirth), 1 male, 12 females; Alexandria, Dyke Marsh, 31.v.1954 (Wirth), 3 males; St. Elmo, vi. (Pratt), 8 females.

5. *Heteromyia prattii* (Coquillett)  
 (Figs. 5, 6)

*Heteromyia prattii* Coquillett, 1902:88 (female; Virginia); Wirth, 1965:137 (synonym of *fasciata*).

*Heteromyia pratti* Coquillett: Malloch, 1915a:360 (key; Wisconsin record); Johannsen, 1943:783 (list); Johannsen, 1952:163 (key; variety of *fasciata*).



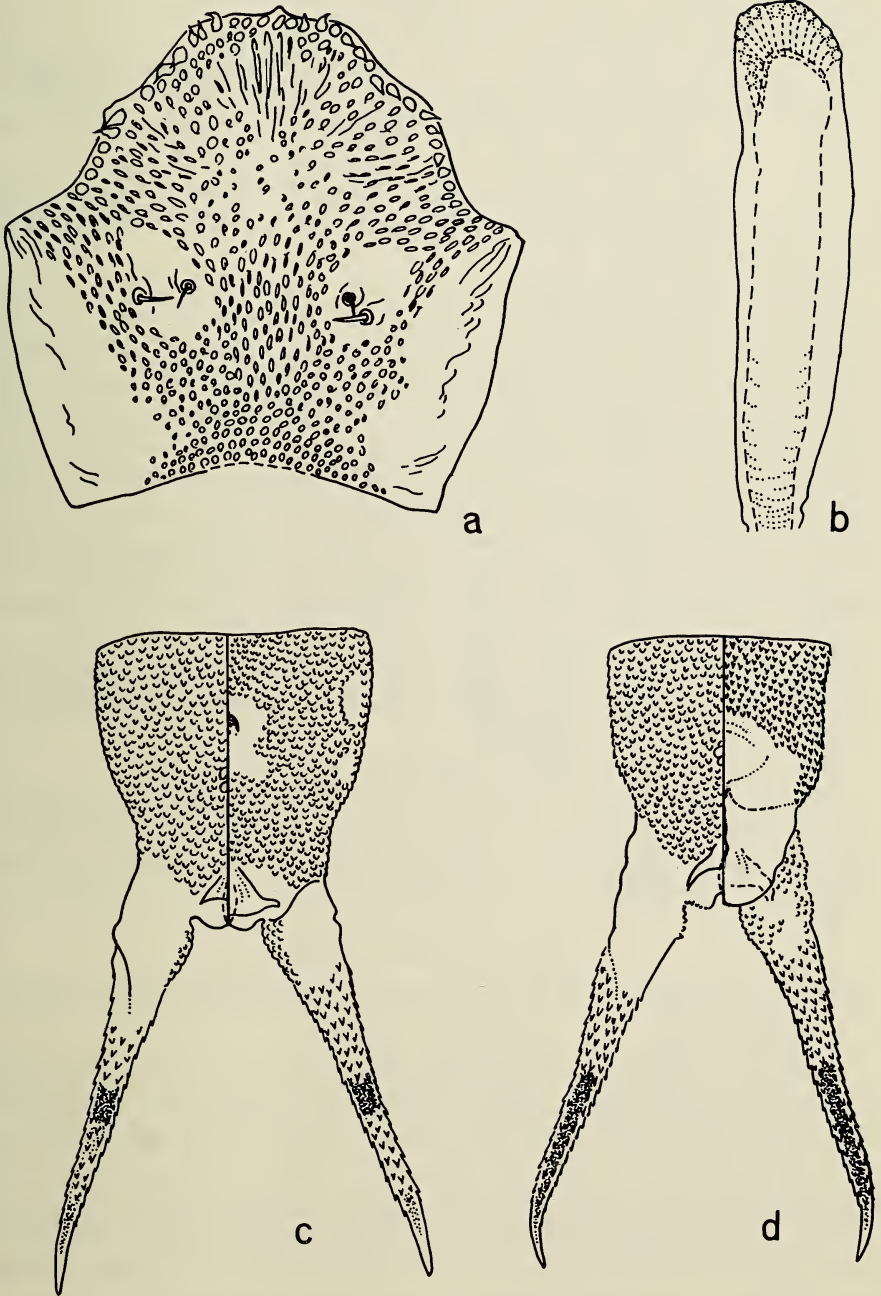


Fig. 6. *Heteromyia prattii*, pupa: a, operculum; b, respiratory horn; c, female terminal segment; d, male terminal segment.

*Female diagnosis*.—Very closely related to *H. fasciata* but a slightly larger and darker species lacking the whitish pruinosity on the dorsum of the abdomen. Wing length 2.95–3.77 mm. Legs (Fig. 5d) yellowish brown; proximal  $\frac{2}{3}$  of hind femur dark brown; middle and hind tibiae dark brown to blackish. Abdomen with conspicuous segmental alternating pale and dark bands.

*Male*.—Similar to female but smaller and slightly darker; aedeagus (Fig. 5e) with expanded tip; parameres (Fig. 5f) with expanded distal portions and broad basal arms.

*Immature stages*.—Larva unknown. Pupa (Fig. 6a–d) 7.0 mm long; brown with coarse shagreening. Operculum (Fig. 6z) as broad as long, surface with coarse pointed tubercles as figured, anterior end rounded, posterior portion with a pair of low rounded tubercles each bearing two short setae. Respiratory horn (Fig. 6b) 4.5 times as long as broad, spatulate and nearly straight, with 15 apical spiracles; surface smooth. Female terminal segment (Fig. 6c) 0.9 times as broad as long, covered with scattered small pointed tubercles as figured; apicolateral processes long and slender, 1.3 times as long as segment, moderately divergent, with sharp-pointed tips, covered densely except at base with small sharp spines and short setae. Male terminal segment (Fig. 6d) similar to female except for the well-developed genital processes which lack the spinose vestiture.

*Biology*.—Shahin Navai reared a male and a female of this species from pupae found in sphagnum moss in the floodplain of the Patuxent River in Prince George's County, Maryland.

*Distribution*.—Illinois east to Ontario and south to Florida.

*Potomac Valley records*.—MARYLAND: Prince George's Co., Patuxent Res. Ctr., 13.vi.1977 (Navai), 1 male, 1 female, with pupal exuviae, reared from sphagnum. VIRGINIA: Alexandria, St. Elmo, 9.vi. (Pratt), 1 female (lectotype); Alexandria, 11.vi–6.vii.1952 (Wirth), 1 male, 12 females.

### Genus *Neurohelea* Kieffer

*Neurohelea* Kieffer, 1925:112. Type-species, *Ceratopogon luteitarsis* Meigen, by monotypy.

*Diagnosis*.—Moderately large midges; body almost bare. Eyes bare and separated. Female antennal segments 3–10 oval, segments 11–15 elongated (Fig. 7a); male antenna with sparse plume. Palpus slender; third segment not swollen, without sensory pit. Mesonotum without anterior tubercle. All femora slender and unarmed (Fig. 7b); fifth tarsomere of front leg swollen in both sexes (Fig. 7c); female claws large, equal on all legs, with basal inner tooth. Wing (Fig. 7d) moderately broad, without infuscated pattern; media forking at r–m crossvein; two well-developed radial cells, costa extending beyond R4+5. Male genitalia (Fig. 7f) with spiculate membrane

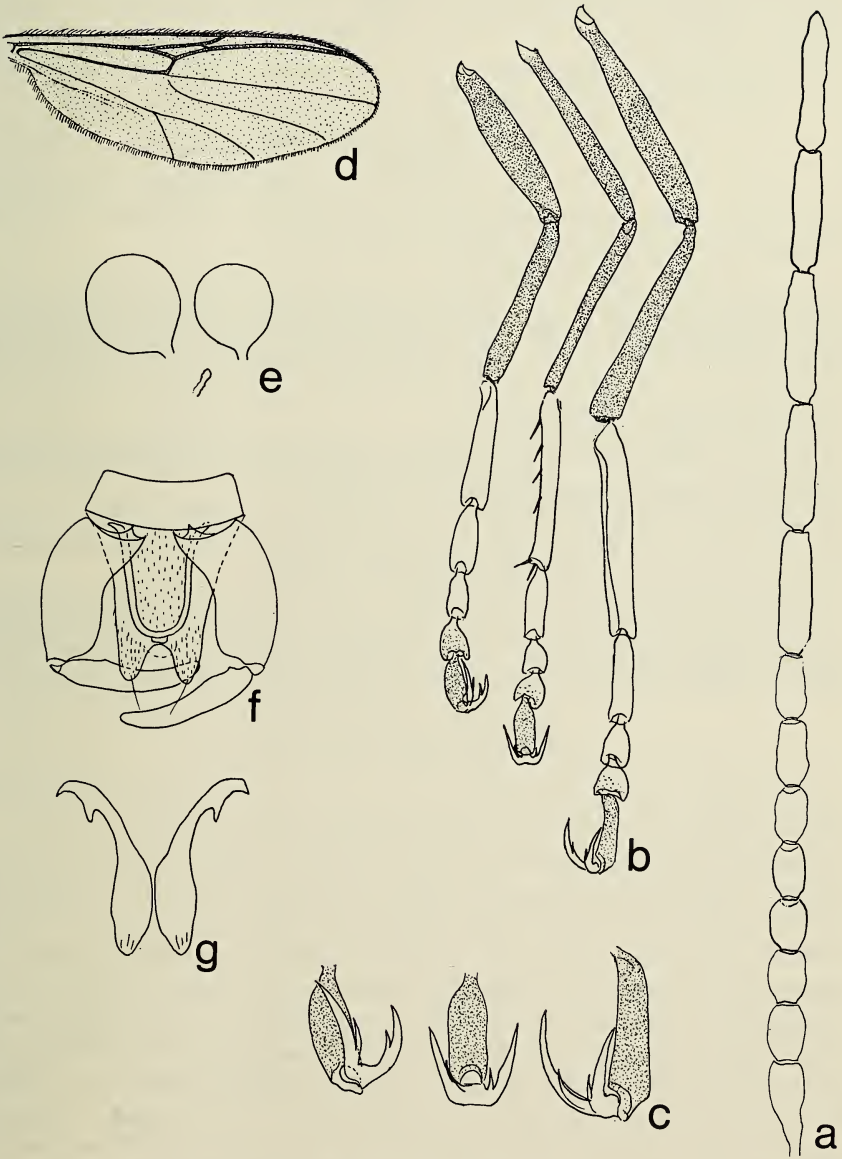


Fig. 7. *Neurohelea nigra*: a-e, female; f-g, male genitalia; a, flagellum; b, leg pattern; c, fifth tarsomere and claws; d, wing; e, spermathecae; f, genitalia, parameres removed; g, parameres.

on ventral face continuous to apex; aedeagus a sclerotized arch with rounded apex and parallel sides; parameres (Fig. 7g) separate, each forming a spatulate lobe distally.

*Immature stages.*—Unknown.

6. *Neurohelea nigra* Wirth  
(Fig. 7)

*Neurohelea nigra* Wirth, 1952:208 (male, female; California; fig. wing, tarsus, antenna, spermathecae, male genitalia).

*Diagnosis.*—Wing 1.8 mm long. A uniformly shining brownish black species except proximal four tarsomeres yellowish; wing grayish hyaline, veins yellowish to brownish; halter brownish infuscated. Structural details as in Fig. 7.

*Immature stages.*—Unknown.

*Biology.*—The species was swept from vegetation in an *Osmunda* bog area and at the margin of a small stream in Virginia.

*Distribution.*—British Columbia and California (Wirth, 1965). Unpublished records in the USNM collection from Oregon, Washington, Tennessee, Virginia, North Carolina, and Georgia.

*Potomac Valley records.*—VIRGINIA: Alexandria, 2–17.vi.1951 (Wirth), from *Osmunda* fern bog and stream margin, 5 females. Fairfax Co., Falls Church, Holmes Run, 1.vi.1961 (Wirth), light trap, 1 female.

Tribe SPHAEROMIINI Newman

*References.*—Wirth, 1962a:272 (key to genera; revision of North American species); Debenham, 1974:15 (revision of Australian species).

*Diagnosis.*—Large, nearly bare, predaceous midges. Female antenna elongate, distal segments usually longer, cylindrical. Palpus five-segmented, usually rather short; third segment slender, without sensory pit. Female mandible with 7–12 strong teeth. Wing without macrotrichia; costa extending to more than  $\frac{3}{4}$  wing length; media broadly sessile. Female tarsal claws large and straight to gently curved. Tarsi with fourth tarsomere cylindrical or cordiform; fifth tarsomere of female armed ventrally with stout spines (batonnets) (Fig. 8d). Female abdomen (Fig. 8a) without internal sclerotized gland rods or eversible glands. Two strongly sclerotized spermathecae, a rudimentary third often present (Fig. 8a). Male genitalia (Fig. 8b) usually long and slender; basistyle simple; dististyle usually long and slender (both structures fused in *Nilobezzia*); aedeagus simple with low basal arch, distal process short; parameres separate, slender, distal blades usually clavate and markedly curved ventrad.

*Immature stages.*—Larval head with lateral arms of epicranial suture

usually obsolescent on anterior half of head, as in tribes Heteromyiini and Palpomyiini. Pupa often with membranous glandular discs present on ventral sides of several abdominal segments.

#### Key to the Known Pupae of Potomac Valley Sphaeromiini

- |   |   |
|---|---|
| 1. Posterior margin of operculum attached | 2   |
| – Posterior margin of operculum free      | 3   |
| 2. Abdomen with ventral glandular discs   |   |
|   | ( <i>Jenkinshelea albaria</i> (Coquillett)) |
|   | ( <i>Probezzia</i> spp. (part))             |
| – Abdomen without ventral glandular discs | <i>Probezzia</i> spp. (part)                |
| 3. Abdomen with ventral glandular discs   | <i>Mallochohelea</i> spp.                   |
| – Abdomen without ventral glandular discs | 4   |
| 4. Posterior margin of operculum truncate |   |
|   | <i>Johannsenomyia argentata</i> (Loew)      |
| – Posterior margin of operculum convex    |   |
|   | <i>Sphaeromias longipennis</i> (Loew)       |

#### Genus *Jenkinshelea* Macfie

*Jenkinsia* Kieffer, 1913:161. Type-species, *Jenkinsia setosipennis* Kieffer, by original designation. Preoccupied by Jordan and Evermann, 1896 (Pisces). *Jenkinshelea* Macfie, 1934:177 (new name for *Jenkinsia* Kieffer). Type-species, *Jenkinsia setosipennis* Kieffer, automatic.

*Reference*.—Grogan and Wirth, 1977a:126 (revision of North American species).

*Diagnosis*.—Body slender, usually pollinose. Legs slender, unarmed; fifth tarsomere of female armed ventrally with several stout batonnets (Fig. 8d); female claws equal, each with blunt basal external tooth. Wing (Fig. 8c) broad in female with greatly expanded anal angle, narrow in male with normal anal angle; two radial cells, the second greatly elongated in female; female abdomen (Fig. 8a) with sternum fused with tergum on each of segments eight and nine forming subcylindrical structures; male genitalia elongate (Fig. 8b); aedeagus fairly short, apex usually rounded; parameres fused at base, divided distally, the tips usually slender, recurved, and bent ventrad.

*Immature stages*.—Larva as described for *J. albaria*. Pupa with respiratory horn very short, abdominal tubercles large, bent backward; abdominal segments six and seven with ventral glandular discs.

*Biology*.—*J. albaria* (Coquillett) has been reared from river margins in Virginia and Texas and a pond margin in Florida. *J. magnipennis* (Johannsen) has been reared from a lake margin in Ontario where pupae climbed

up above the water line and secured themselves by their adhesive discs to the side of a boat. When Wirth brought pupae of *J. albaria* into the laboratory for rearing, they rapidly climbed up the glass walls of the vials, using their discs for adhesion and moving by moderately rapid, lateral, bending movements of the body. The discs secreted a fluid by which the pupa became fixed to the vial when movement stopped. When the pupae sometime later were forcibly pried loose from the vial, the pattern of the dried fluid on the glass marked the exact outline of the glandular discs.

7. *Jenkinshelea albaria* (Coquillett)  
(Figs. 8, 9)

*Ceratopogon albarius* Coquillett (as *albaria*), 1895:308 (female; Florida).  
*Johannsenomyia albaria* (Coquillett); Malloch, 1915a:335 (Illinois; synonym of *J. magnipennis* (Johannsen)).

*Jenkinshelea albaria* (Coquillett); Johannsen, 1943:783 (combination; eastern U.S.); Wirth, 1962a:1 (redescription; key; fig. male genitalia); Grogan and Wirth, 1977a:129 (redescribed, figures; distribution).

*Johannsenomyia aequalis* Malloch, 1915a:336 (male; Illinois); Johannsen, 1943:378 (New York); Wirth, 1962a:2 (synonym of *J. albaria*).

*Female diagnosis*.—Wing length 3.08 mm. Thorax grayish pollinose in dry specimens. Legs brown, usually with front femur, proximal 0.75 of middle and hind femora, front tibia, and broad subapical bands on middle and hind tibiae yellowish to pale brown; tarsomeres one and two pale; claws (Fig. 8b) with basal outer teeth. Wing (Fig. 8c) membrane milky whitish on proximal third, pale smoky brown on distal two-thirds; r-m crossvein dark brown. Halter knob white. Abdomen whitish except segments eight and nine brown, venter reddish brown. Genitalia as in Fig. 8a; eighth and ninth segments each with a pair of ventrolateral sclerotized spinelike tubercles at midlength.

*Male*.—Smaller than female, integument shining black, without grayish pollen; femora and tibiae entirely brown; halter brown. Genitalia as in Fig. 8b.

*Larva* (4th Instar).—Length 8–10 mm. Head long and slender (Fig. 9a); 2.5 times longer than broad; eye situated on epicranial suture; dorsum with chaetotaxy and sensilla as follows: two pairs of pits encroaching on anterior margin of postoccipital ridge; two pairs of setae near posterior margin of epicranial suture; *r* seta just laterad of eye; *m* pit anterior to eye; *q* seta anterior to eye and immediately laterad of epicranial suture; *s* and *k* pits anteriorad of *q* seta; *z* seta laterad of epicranial suture; *x* seta short; *w* seta apparently absent. Venter of head with chaetotaxy as follows: *y* pit opposite eye; single *u* and *v* setae on lateral margins opposite *s* and *k* pits; two pairs of *o* pits; *n* pit anterior to *o* pits; and *t* seta unbranched. Terminal seg-

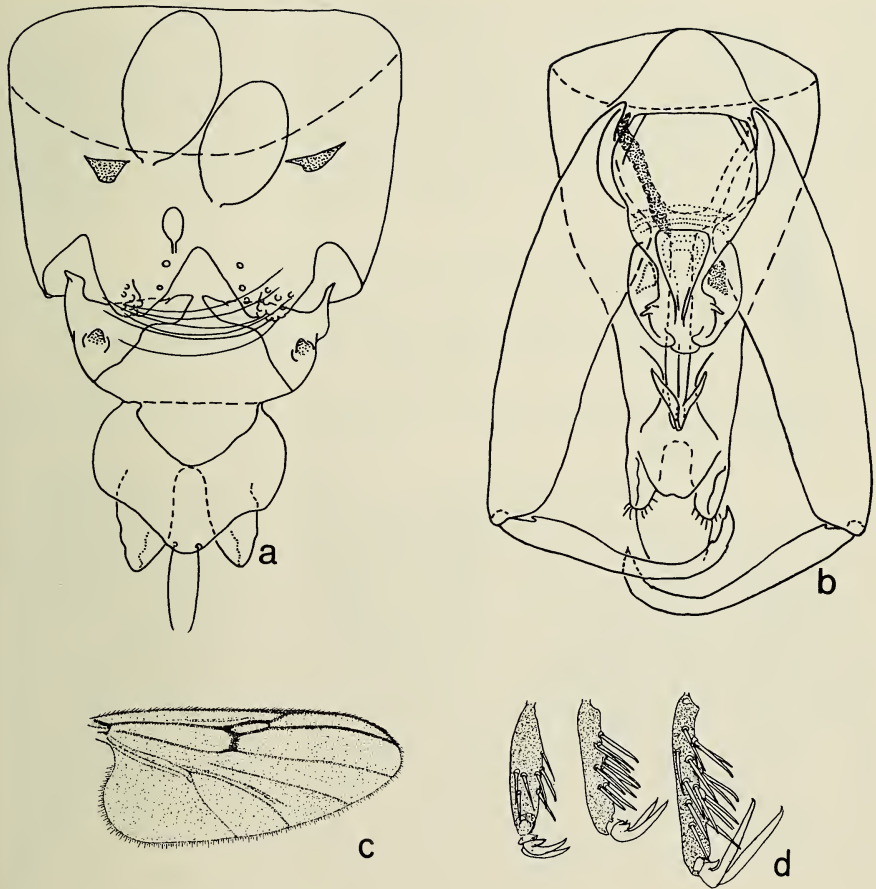


Fig. 8. *Jenkinshalea albaria*: a, female genitalia; b, male genitalia; c, female wing; d, female fifth tarsomere and claws.

ment of abdomen (Fig. 9b) about 3 times longer than broad; posterior end with four pairs of slender setae, the anterior two pairs half the length of the two posterior pairs.

*Pupa*.—Brown. Female operculum (Fig. 9d) about as long as broad, surface covered with small rounded tubercles; anterior end rounded, tip pointed; central portion with raised areas bearing a pair of tubercles, the posterior one with a single long seta; lateral margins greatly elevated; posterior margin attached. Male operculum similar to that of female but slightly narrower. Respiratory horn (Fig. 9c) 2.5 times longer than broad; surface smooth; apex with double row of 5–8 spiracles. Female terminal segment (Fig. 9e) about twice as long as broad; dorsum covered with

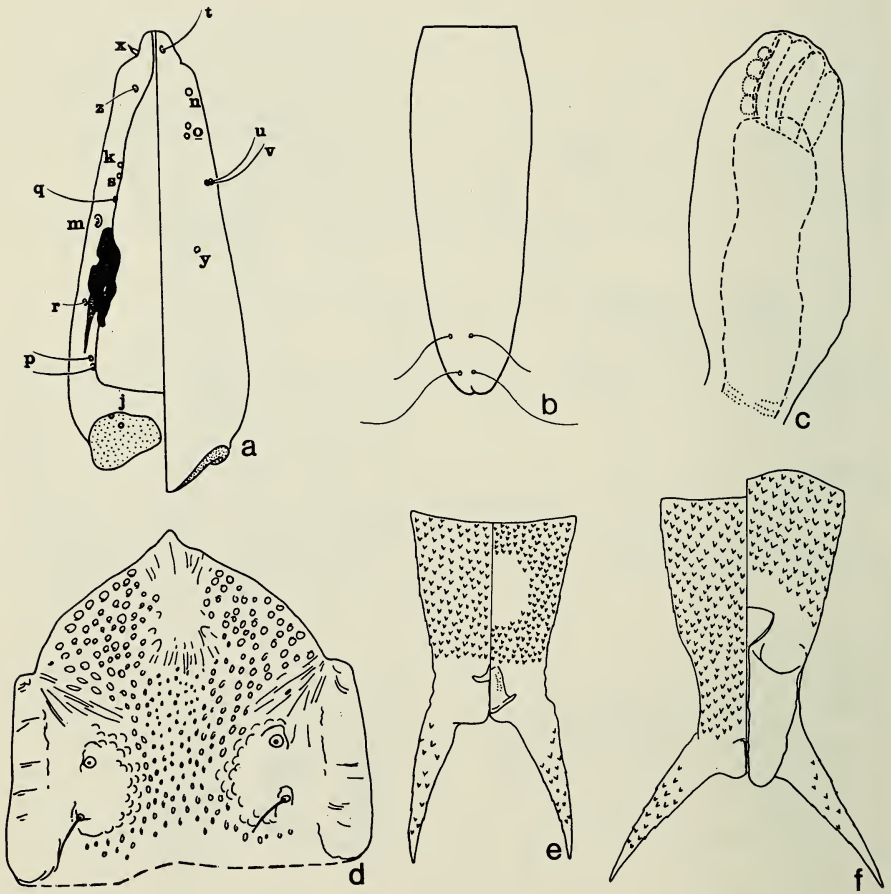


Fig. 9. *Jenkinshalea albaria*: a-b, larva; c-f, pupa; a, head capsule; b, terminal segment; c, respiratory horn; d, operculum; e, female terminal segment; f, male terminal segment.

small pointed tubercles; venter covered with small pointed tubercles except for a small circular central area; apicolateral processes moderately divergent, covered with small pointed tubercles. Male terminal segment (Fig. 9f) 1.7 longer than broad; dorsum covered with small pointed tubercles; venter covered with small pointed tubercles on distal half, genital processes tightly appressed and very slightly wrinkled; apicolateral processes greatly divergent, covered with small pointed tubercles.

*Biology*.—This species has been reared from river margins in Virginia and Texas and from a pond margin in Florida.

*Distribution*.—Ontario south to Florida, west to Texas and Illinois.



*Potomac Valley records*.—MARYLAND: Montgomery Co., Plummers Island, 24.ix.1902 (Barber and Schwarz), 16 females; 1.viii.1903 (Busck), 1 female; 8.vi.1914 (Schwarz and Shannon), at light, 2 females (male genitalia attached); 2.vii.1915 (Shannon), 1 female. VIRGINIA: Fairfax Co., Potomac River at Scott Run, 7.vi.1955 (Wirth and Jones), reared from sandy river margin, 200 males, females, with pupal exuviae and 3 larvae; 12.vii.1976 (Wirth and Grogan), 1 pupa.

### Genus *Johannsenomyia* Malloch

*Johannsenomyia* Malloch, 1915a:332. Type-species, *Johannsenomyia halteralis* Malloch, by designation of Wirth, 1952:211; synonym of *J. argentata* (Loew).

*Dicrohelea* Kieffer, 1917:363. Type-species, *Palpomyia filicornis* Kieffer, by designation of Macfie, 1940:26.

*Reference*.—Wirth, 1962a:276 (revision; synonymy).

*Diagnosis*.—Slender, nearly bare midges, usually shining species. Legs long and slender; fifth tarsomere of female armed ventrally with numerous long, black, blunt spines (batonnets); fifth tarsomere of male hind leg armed with 2–3 pairs of ventral batonnets; claws of female equal on front legs, very unequal on middle and hind legs, the longer claw only slightly curved, each claw with short, stout, basal tooth on external side; wing with two radial cells; female abdomen more or less petiolate, eighth segment without sclerotization or ventral hair tufts; two large spermathecae present. Male genitalia rotated and appressed obliquely against apex of abdomen with sternal side facing caudad; aedeagus broad, with well-developed basal arch and broad, caplike tip; parameres separate, the distal portions approximate, basal portion of each slender and curved, distal portion expanded into a broad, platelike, laterally flattened tip.

*Immature stages*.—Larva undescribed. Pupa with respiratory horn 3–4 times as long as breadth of flaring portion; abdominal tubercles inconspicuous, not conical or angulate; abdominal sterna without glandular discs.

*Biology*.—Williams (1955) presented a very interesting account of the habits of the larvae of *J. argentata* on the sandy beach of Douglas Lake, Michigan, near the University of Michigan Biological Station. Beach sand from near the lake margin was mixed with lake water and poured into a white enamel pan where the larvae could be seen swimming about. One or two larvae were found per bucket of sand. Larvae were not numerous at the margin where the lake water met the sandy beach. When pupation time approached, submerged larvae swam to the water surface where they headed for the beach and rapidly burrowed into the sand. About ten days after pupation, adults of *J. argentata* emerged.

8. *Johannsenomyia argentata* (Loew)  
(Figs. 10, 11)

- Ceratopogon argentatus* Loew, 1861:310 (Cent. 1, no. 5) (female; D.C.).  
*Johannseniella argentata* (Loew); Malloch, 1914:226 (combination).  
*Johannsenomyia argentata* (Loew); Malloch, 1915a:334 (combination; female redescribed; Illinois); Wirth, 1962a:277 (redescribed; figs.; distribution).  
*Sphaeromyias argentatus* (Loew); Kieffer, 1917:315 (combination).  
*Dicrohelea argentata* (Loew); Johannsen, 1943:783 (combination; distribution); Williams, 1955:96 (larval habits; Michigan).  
*Johannsenomyia halteralis* Malloch, 1915:338 (in part, type male; Illinois); Wirth, 1962a:277 (synonym of *J. argentata*; notes on type).

*Female diagnosis*.—Wing (Fig. 10a) length 2.5–3.0 mm. Subshining brownish black. Antenna brown, segments 3–10 annulate, with yellow proximal ends, antenna very elongate, 11th segment 12 times as long as broad. Legs (Fig. 10b) yellow, hind femur often with extensive distal infuscation leaving a prominent subapical yellow ring (Fig. 10c); hind tibia often with proximal half infuscated; fifth tarsomeres (Fig. 10f) black, with 4–5 pairs of batonnets. Wing uniformly brownish gray infuscated; halter brownish. Abdomen dark brown, dorsum with prominent silvery pruinosity; genitalia as in Fig. 10d; spermathecae (Fig. 10e) two, ovoid, unequal, without sclerotized necks, third spermatheca absent.

*Male*.—Similar to female but smaller, legs more extensively darkened, broad bases of front and middle femora more or less yellowish; abdomen shining brown above, without silvery pollen; fifth tarsomere (Fig. 10g) on hind leg with 2–3 pairs of black ventral batonnets. Genitalia (Fig. 10h) as figured; aedeagus with low basal arch, laterally flaring basal arms, and stout, caplike distal portion; parameres (Fig. 10i) each with apex flattened laterally and expanded dorsoventrally in a large, platelike lobe.

*Immature stages*.—Larva not described. Pupa: Respiratory horn (Fig. 11a) 2.5 times longer than broad; narrow proximally, broader distally; surface smooth; apex with 24–30 spiracles. Operculum (Fig. 11b) 1.25 times longer than broad; anterior portion and central area of posterior portion covered with small rounded tubercles; anterior end rounded; posterolateral margins parallel, surface smooth with two pairs of tubercles each bearing a moderately long seta; posterior end truncate. Female terminal segment (Fig. 11c) 1.4 times broader than long; anterior third of dorsum and venter covered with small pointed tubercles; apicolateral processes greatly divergent, surface smooth. Male terminal segment (Fig. 11d) 1.4 times broader than long; anterior half of dorsum and anterior fourth of venter covered with small pointed tubercles; apicolateral processes greatly divergent,

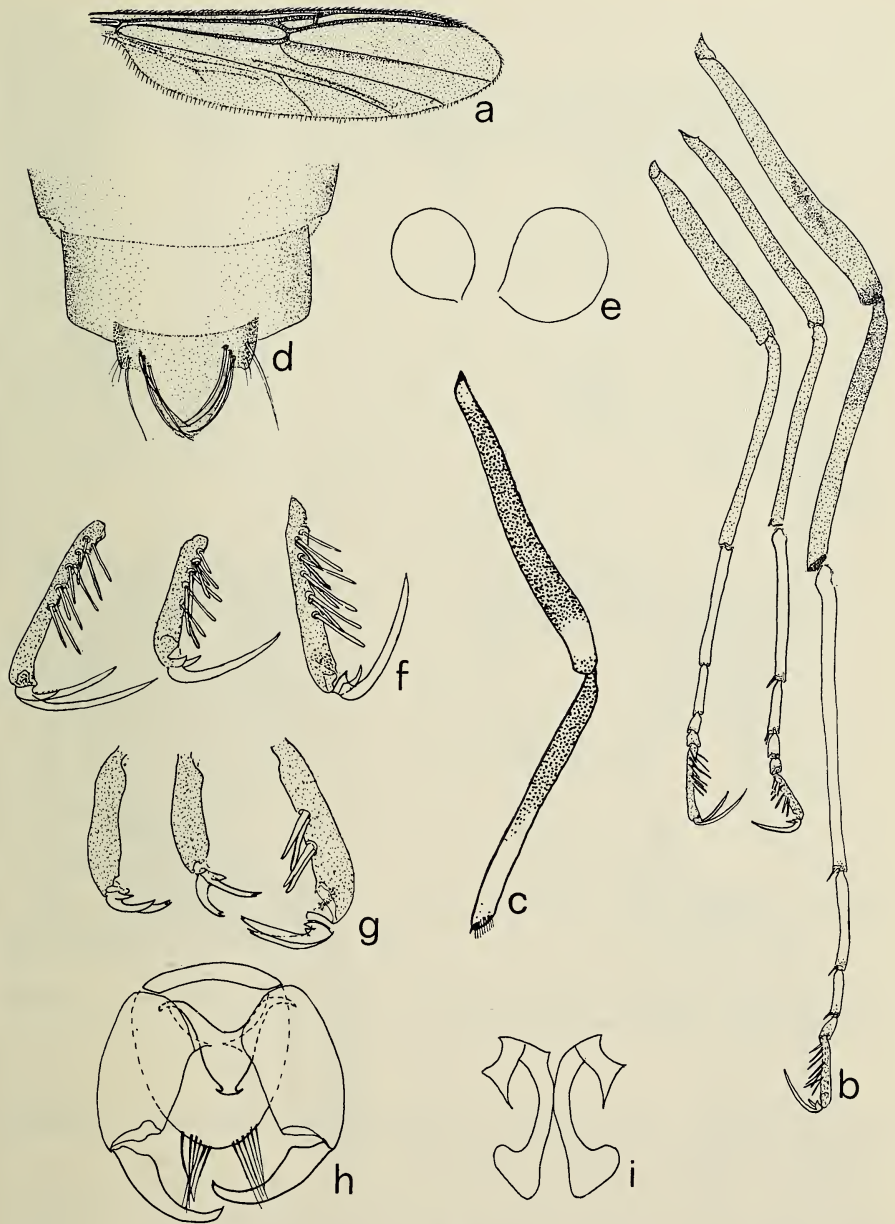


Fig. 10. *Johannsenomyia argentata*: a-f, female; g-i, male; a, wing; g, leg pattern; c, alternate hind leg pattern; d, terminal abdominal segments; e, spermathecae; f-g, fifth tarsomeres and claws; h, genitalia, parameres removed; i, parameres.

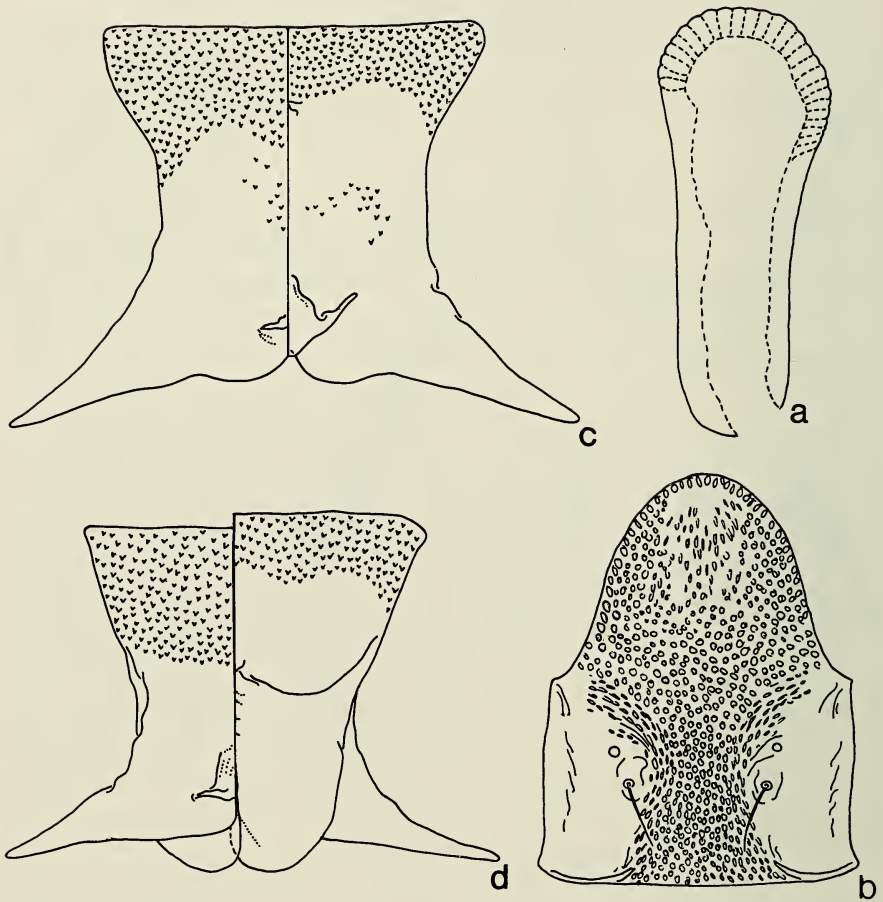


Fig. 11. *Johannsenomyia argentata*, pupa: a, respiratory horn; b, operculum; c, female terminal segment; d, male terminal segment.

surface smooth; ventral genital processes greatly appressed, extending beyond body, surface slightly wrinkled.

*Biology*.—Wirth and Jones reared this species from the sandy margin of the Potomac River at Scott Run, Virginia. Note Williams' observations on the habits of the larvae in the generic discussion above.

*Distribution*.—North Dakota to Ontario, south to Texas and Florida.

*Potomac Valley records*.—D.C.; Washington (Osten Sacken), 4 females (syntypes, in Museum of Comparative Zoology, Cambridge, Mass.). MARY-

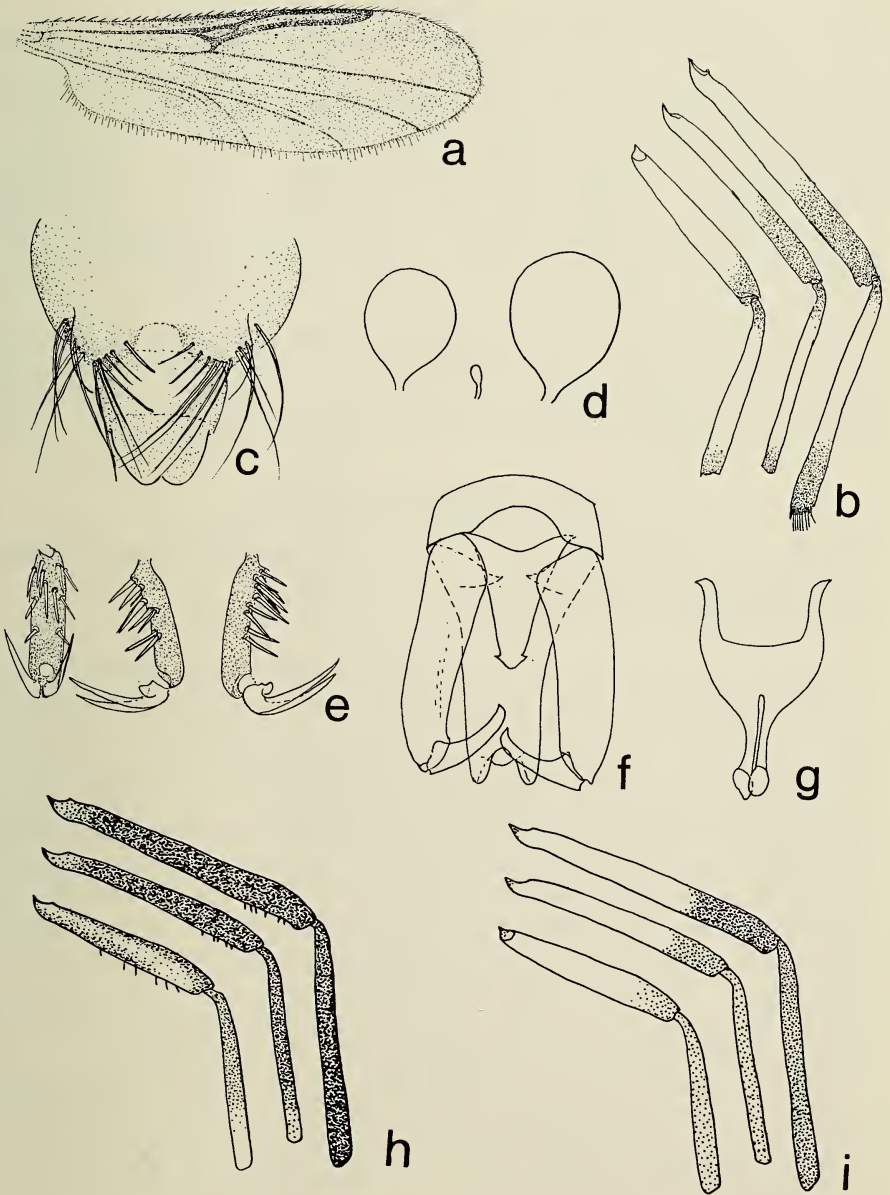


Fig. 12. *Mallochohelea albibasis*, a-g; *M. atripes*, h: a-e, female; f-g, male; a, wing; b, leg pattern; c, terminal abdominal segments; d, spermathecae; e, fifth tarsomere and claws; f, genitalia, parameres removed; g, parameres; h-i, female leg patterns.

LAND: Cabin John, 10.viii.1916 (Fouts), 1 female. Herzog Island, 23.viii.1914 (Shannon), 1 female. Plummers Island, vi.1902, vi.1905, viii.1906 (Barber), 8 females; 11.viii.1907 (Fisher), 1 female; 28.vi.1914 (McAtee), 1 female; vi.1914, viii.1915 (Shannon), 6 females. VIRGINIA: Alexandria, 29.vi, 6.vii.1952 (Wirth), 4 males, 2 females. Fairfax Co., Dead Run, 22.vi.1915 (Shannon), 4 females. St. Elmo, 30.vi (Pratt), 4 females. Great Falls, vi.1922 (Aldrich), 1 female; 21.vi.1931 (Melander), 2 females; 12.vi.1949 (Wirth), 2 females. Potomac River at Scott Run, 7.vi.1955 (Wirth and Jones), reared from river margin, 11 males, 10 females, some with pupal exuviae.

*Discussion.*—Wirth (1962a) recorded *J. annulicornis* Malloch from the Scott Run, Virginia series. Re-examination of the genitalia reveals that this specimen was misidentified, and is actually *J. argentata*. Males of *J. annulicornis* differ by the shape of the parameres.

#### Genus *Mallochohelea* Wirth

*Mallochohelea* Wirth, 1962a:278. Type-species, *Johannsenomyia albibasis* Malloch, by original designation.

*Johannsenomyia* Malloch of authors.

*Reference.*—Wirth, 1962a:278 (revision of North American species).

*Diagnosis.*—Body slender to moderately stout, nearly bare, integument usually shining. Femora (Fig. 12b, h, i) with or without ventral spines; fifth tarsomeres of female (Fig. 12e) armed ventrally with 5–8 pairs of stout, black, blunt spines (batonnets); female claws long, equal, bent at base, nearly straight distally, each claw with short basal tooth on external side. Wing (Fig. 12a) with two radial cells (rarely only one); anal angle not broadened; costa short, usually extending to about 0.8 of wing length. Female abdomen (Fig. 12c) without internal gland rods; eighth segment with pair of ventral hair tufts. Male genitalia (Fig. 12f) with long basistyle and dististyle; aedeagus with low basal arch, tapering distally to moderately broad, caplike tip; parameres (Fig. 12g) usually fused in midportion forming a rounded basal arch, the tips separate but contiguous.

*Immature stages.*—Larva: see *M. atripes* for description. According to Glukhova (1977) the larva of the Palaearctic species *M. inermis* (Kieffer) has the head moderately broad and tapering, the *o* and *u* hairs multiple; the epipharynx with one pair of combs and a toothed comb on the lateral arm. Pupa with respiratory horn very short (Figs. 13c–e; 14a), 1.5–2.0 times as long as broad; abdominal segments with prominent, angular, backward projecting, spinose tubercles; abdominal sterna six and seven with membranous glandular discs; apicolateral processes relatively short and pointed.

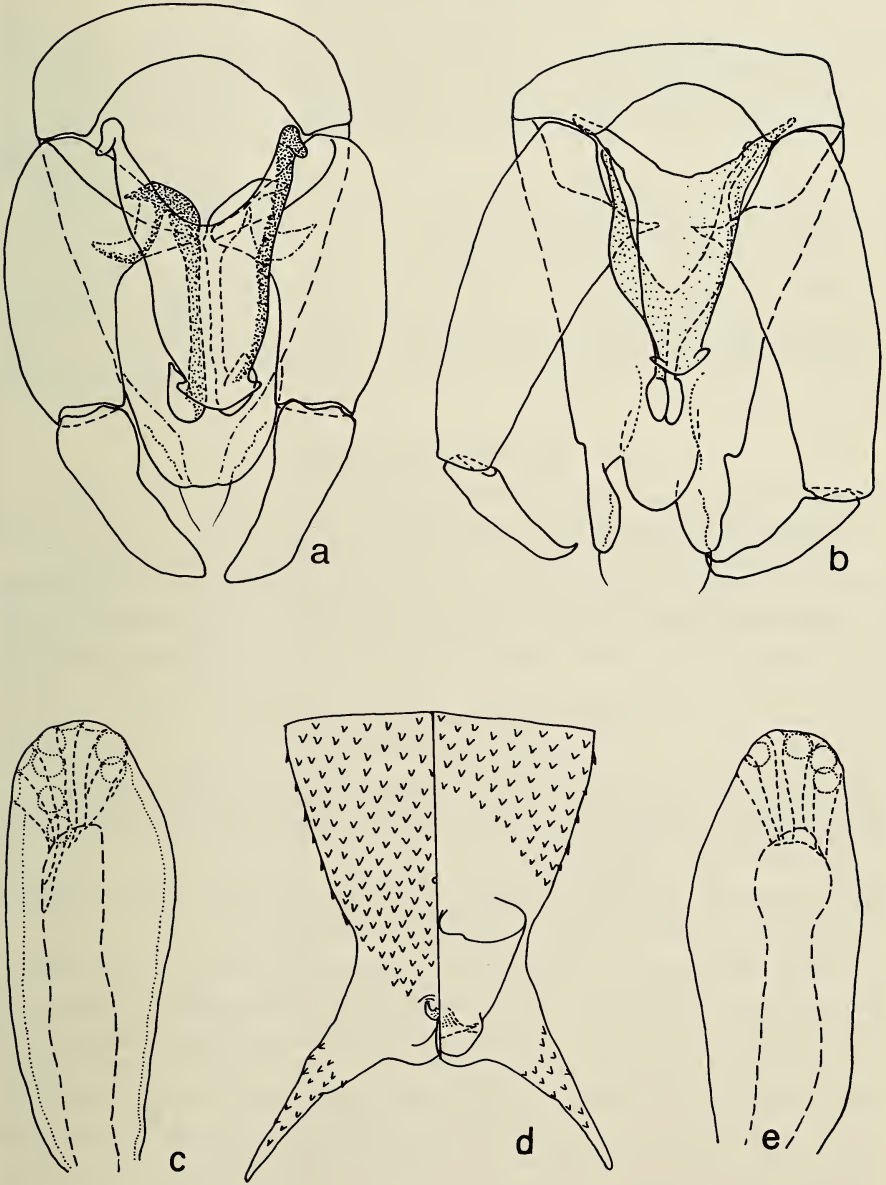


Fig. 13. *Mallochohelea atripes*, a; *M. albihalter*, b, e; *M. albibasis*, c-d: a-b, male genitalia; c-e, pupal respiratory horns; d, terminal segment of male pupa.

Key to Potomac Valley Species of *Mallochohelea*  
(Primarily for Females)

1. Femora and tibiae entirely blackish, at least on hind legs (Fig. 12h); antenna including scape, halter, and abdomen blackish; all femora armed (Fig. 12h); base of front femur and apex of front tibia paler  
*atripes* Wirth
- Femora and tibiae with conspicuous pale bands, except sometimes hind tibia entirely dark (Fig. 12i); antenna, halter and abdomen various; femora unarmed (Fig. 12i) 2
2. Halter dark; wing whitish at base, infuscated on distal two-thirds.  
*albibasis* (Malloch)
- Halter pale; wing uniformly whitish to pale grayish hyaline  
*albihalter* Wirth

Key to Known Pupae

1. Apicolateral processes with small pointed tubercles (Fig. 13d); respiratory horn with 5–10 spiracles (Fig. 13c, e) 2
- Apicolateral processes smooth, lacking small pointed tubercles (Fig. 14e, f); respiratory horn with 18–20 spiracles (Fig. 14d) *atripes* Wirth
2. Respiratory horn with 5–6 spiracles (Fig. 13e) *albihalter* Wirth
- Respiratory horn with 10 spiracles (Fig. 13c) *albibasis* (Malloch)

9. *Mallochohelea albibasis* (Malloch)  
(Figs. 12a–g, 13c–d)

*Johannsenomyia albibasis* Malloch, 1915b:315 (male, female; Illinois).

*Mallochohelea albibasis* (Malloch); Wirth, 1962a:379 (combination; re-described; figs.; distribution).

*Johannsenomyia halteralis* Malloch, 1915a:338 (in part, allotype female; misident.); Wirth, 1952:212 (California; re-described).

*Female diagnosis*.—A small slender species, wing 2.0 mm long. Thorax shining black. Wing (Fig. 12a) white at base, infuscated on distal two-thirds. Halter infuscated. Antenna entirely brown, eleventh segment 4.3 times as long as broad; face and palpus pale. Legs (Fig. 12b) yellow; front knee, extreme tip of front and middle tibiae, distal third of middle and hind femora, distal fourth to  $\frac{3}{4}$  of hind tibia, and fifth tarsomeres blackish; fifth tarsomeres (Fig. 12e) with five pairs of batonnets. Abdomen pale at base, brownish black distally. Spermathecae (Fig. 12d) unequal, ovoid, with moderately long necks.

*Male*.—Marked as in female. Male genitalia as in Fig. 12f; parameres (Fig. 12g) with distinctly expanded tips.



*Immature stages.*—Larva unknown. Pupa with respiratory horn (Fig. 13c) 2.5 times longer than broad, surface smooth; apex with about 10 spiracles. Male terminal segment (Fig. 13d) 1.3 times longer than broad; dorsum covered with scattered small pointed tubercles; anterior third of venter covered with small pointed tubercles; genital processes short, greatly appressed; apicolateral processes moderately divergent, covered with small pointed tubercles.

*Biology.*—Unknown.

*Distribution.*—Northwestern Canada to Quebec, south to California and Alabama.

*Potomac Valley records.*—MARYLAND: Montgomery Co., Fairland, 12.v.1959 (Hubert), 1 female; Forest Glen, 12.vi.1966 (Wirth), 1 female. VIRGINIA: Fairfax Co., Falls Church, Holmes Run, 9.vi.1961 (Wirth), 1 female; Great Falls, 19.v.1915 (McAtee), 1 female.

10. *Mallochohelea albihalter* Wirth  
(Figs. 12i, 13b, e)

*Mallochohelea albihalter* Wirth, 1962a:280 (male, female; figs.; Michigan).

*Female diagnosis.*—A small, moderately stout species, wing 2.0 mm long. Thorax and abdomen subshining brownish black. Head dark brown, including palpus and entire antenna; the latter short, distal segments not greatly elongated, eleventh segment 3.5 times as long as broad. Legs (Fig. 12i) yellow; extreme apex of front femur, distal fourth of middle and hind femora, extreme apices of front and middle tibiae, and distal fourth of hind tibia brownish black; tarsomeres 3–5 brownish; fifth tarsomeres with five pairs of batonnets. Wing uniformly whitish to pale grayish hyaline, veins yellowish white; halter whitish. Abdomen not pale at base; spermathecae unequal, ovoid, tapering to very short, sclerotized neck.

*Male.*—Color as in female, pale markings of legs not so extensive; distal antennal segments not greatly elongated. Genitalia (Fig. 13b) shorter and broader than in related species; aedeagus broad at base with short basal arch; sides slightly convex, tapering to rounded, caplike tip; parameres with fused midportion broad, anterior arms slender, distal stems slender with slightly expanded tip.

*Immature stages.*—Larva unknown. Pupa similar to that of *M. albibasis*; respiratory horn (Fig. 13e) with 5–6 spiracles.

*Distribution.*—Wisconsin to Quebec, south to Louisiana and Maryland.

*Biology.*—Unknown.

*Potomac Valley records.*—MARYLAND: Montgomery Co., Plummers Island, 10.v.1905 (Barber and Schwarz), 1 female; 8.vi.1914 (Schwarz and Shannon), 1 female.

11. *Mallochohelea atripes* Wirth  
(Figs. 12h, 13a, 14)

*Mallochohelea atripes* Wirth, 1962a:281 (male, female; New Jersey; figs.).

*Female Diagnosis*.—A large slender species, wing 2.7 mm long. Thorax and abdomen shining black. Head black, face brown, palpus, pedicel and bases of antennal segments 3–10 yellow, apices of segments 3–10 and all of last five segments dark, the distal five very elongate, eleventh segment five times as long as broad. Legs (Fig. 12h) brownish black; front femur except apex and distal portion of front and middle tibiae more or less yellowish brown; tarsomeres one to four whitish; fifth tarsomere with five pairs of batonnets, the fifth, distal one removed toward claws and sharper than the others. Femora with stout, sharp, black ventral spines, ten on distal half of fore leg, and four or five on distal third of mid and hind legs. Spermathecae slightly unequal, ovoid, without sclerotized necks. Wing grayish hyaline, veins brown infuscated. Halter deeply infuscated.

*Male*.—As in female, with usual sexual differences; legs darker, only extreme base of front femur and apex of front tibia yellowish; femoral spines three to five on front leg, 0–1 on middle, and 2–3 on hind leg; fifth tarsomeres unarmed ventrally. Genitalia (Fig. 13a) approaching those of *Johannsenomyia*, parameters separate, slender with expanded, hooked tip; aedeagus short and broad, with spicules ventrally and on the membrane to ninth sternum; ninth tergum bilobed, dististyles well developed.

*Immature stages*.—Larva (fourth instar): Length 9–10 mm. Head elongate and tapering; head capsule (Fig. 14a) 2.5 times longer than broad; a prominent, elongate eye spot situated on epicranial suture. Dorsal chaetotaxy and sensilla of head as follows: two pairs of *j* pits just anterad of post-occipital ridge; two pairs of *p* setae near posterior margin of epicranial suture; *r* pit posterior to eye; *m* pit laterad of eye; *q* seta just anterad of eye; *s* seta single, anterior to *q* seta; *k* pit just anterior to *s* seta; *w* seta on lateral margin just posterior to *z* seta; *x* seta short. Ventral chaetotaxy of head as follows: *y* seta opposite eye; single *v* seta and branched *u* seta opposite *q* seta; anterior pair of *o* pits with seta; *n* pit opposite *o* pits; *t* pit lacking seta. Terminal segment (Fig. 14b) three times longer than broad; posterior end with four pairs of setae, the two posterior pairs longer and slightly stouter than anterior two pairs.

*Pupa*.—Operculum (Fig. 14c) 1.3 times longer than broad, surface covered with small rounded tubercles as figured; anterior margins with large rounded tubercles, anterior end pointed; central portion with a pair of small raised areas; posterior portion with a pair of raised areas each with two pairs of tubercles, the posterior pair bearing a single seta; posterior margin slightly convex and a median posteriorly projecting portion. Respira-

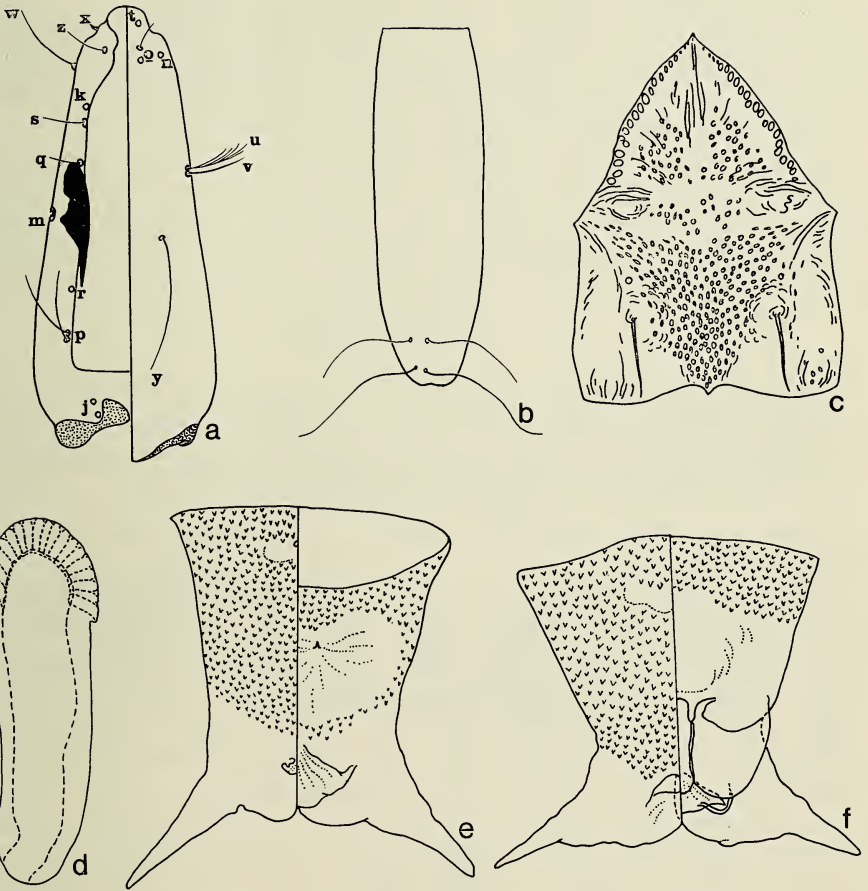


Fig. 14. *Mallochohelea atripes*: a-b, larva; d-f, pupa; a, head capsule; b, terminal segment; c, operculum; d, respiratory horn; e, female terminal segment; f, male terminal segment.

tory horn (Fig. 14d) three times longer than broad, surface smooth; apex with 18-20 spiracles. Female terminal segment (Fig. 14e) slightly longer than broad; dorsum covered with small pointed tubercles; venter covered with small pointed tubercles except for a broad circular central portion; apicolateral processes moderately divergent, surface smooth. Male terminal segment (Fig. 14f) similar to that of female, differing as follows: slightly broader than long; anterior third of venter covered with small pointed tubercles, genital processes very short, greatly appressed; apicolateral processes greatly divergent.

*Biology*.—Grogan recovered numerous larvae and pupae of *M. atripes* from algae-covered purslane taken in the pond at Knowles Marsh 1, Patuxent Wildlife Research Center. The larvae of this species were extremely active and swam near the surface of the water in which they were recovered.

*Distribution*.—Michigan to Ontario, south to Florida.

*Potomac Valley records*.—MARYLAND: Montgomery Co., Fairland, 10.vi.1959 (Hubert), 1 female. Prince George's Co., Patuxent Wildlife Res. Ctr., 2.vi.1958 (Scanlon), light trap, 200 females; 17.v.1976, 4.vi.1976 (Grogan), reared from pond weeds, 4 males, 1 female, 1 pupal exuviae, 1 larva. VIRGINIA: Fairfax Co., Falls Church, 5.vii.1958 (Wirth), 1 female.

### Genus *Probezzia* Kieffer

*Probezzia* Kieffer, 1906:57. Type-species, *Ceratopogon venustus* Meigen, by designation of Coquillett, 1910:594 (synonym of *P. seminigra* (Panzer)).

*Dicrobezzia* Kieffer, 1919:127. Type-species *Ceratopogon venustus* Meigen, by original designation (synonym of *P. seminigra* (Panzer)).

*References*.—Wirth, 1951a:25; 1971:729 (revisions of North American species).

*Diagnosis*.—Body slender and nearly bare. Fourth tarsomeres (Fig. 15g) short, cordiform; female fifth tarsomeres (Fig. 15f) armed with numerous, blunt, strong, black spines (batonnets) ventrally; female claws long, bent at base, straight and flattened distally, each with external basal tooth. Wing (Fig. 15a) with a single long radial cell; costa in female reaching nearly to wing tip; membrane usually milky white with a major part covered with a broad smoky fascia. Female eighth sternum (Fig. 15e) with a pair of prominent submedian tufts of long fine setae on posterior margin. Male genitalia (Fig. 15d) with basistyle long and slender, dististyle short and pointed; aedeagus tapered with short anterior arch and caplike posterior tip; parameres (Fig. 15b) slender, parallel sided, and more or less fused in middle.

*Immature stages*.—Larva (*P. seminigra* (Panzer), after Glukhova, 1977): Head moderately broad, tapering; head hairs *o*, *s*, and *u* multiple; epipharynx with one pair of combs, no combs on lateral arms; last segment with four pairs of rather short hairs arranged subapically on each side rather than around the anus. Pupa with short slender respiratory horn (Figs. 17b, f; 18b, d) bearing 8–10 terminal spiracles; some species with some abdominal sterna provided with large, disclike, glandular areas; apicolateral processes (Figs. 17c, d, g, h, i; 18c, e, f) short and divergent, sharp pointed.

*Biology*.—Weerekoon (1953) found larvae of *P. seminigra* (Panzer) (as *venusta*) common in the bottom mud of Loch Lomond in Scotland, coming to the water surface at night and swimming to shore to pupate. He found their guts filled with red, semi-liquid matter which he believed came from

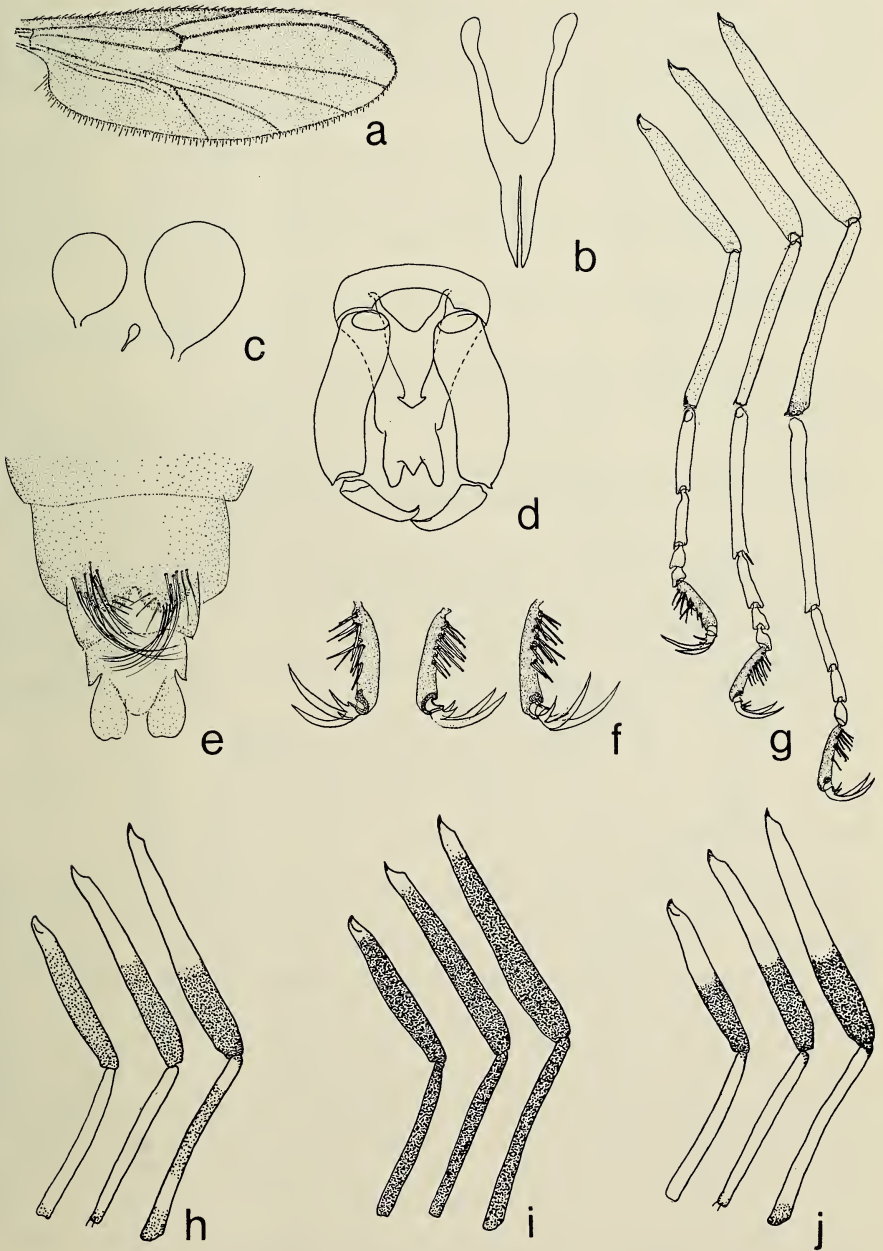


Fig. 15. *Probezzia pallida*, a-g; *P. albitibia*, h; *P. smithii*, i; *P. xanthogaster*, j: a, female wing; b, male parameres; c, female spermathecae; d, male genitalia; e, female genital segments; f, female fifth tarsomeres; g-j, female leg patterns.

feeding on animals containing hemoglobin, probably bloodworms of the family Chironomidae. As reviewed in the introduction, Downes (1971) gave details of the adult feeding and mating habits of *P. seminigra* (as *flavonigra* (Coquillett)) in Alberta.

Key to Potomac Valley Species of *Probezzia*

- |   |                                 |
|---|---------------------------------|
| 1. Wing entirely pale, veins and membrane whitish   | 2                               |
| – Wing whitish with broad dark band, veins in infuscated portion darkened   | 4                               |
| 2. Mesonotum entirely yellowish or pale brownish  |                                 |
|   | <i>pallida</i> Malloch (female) |
| – Mesonotum entirely shining black or dark brown  | 3                               |
| 3. Legs entirely pale except for black fifth tarsomere  |                                 |
|   | <i>pallida</i> Malloch (male)   |
| – Legs with black markings on approximately distal third of femora and extreme tip on hind tibia (Fig. 15j); fifth tarsomeres black   |                                 |
|   | <i>xanthogaster</i> (Kieffer)   |
| 4. Wing with dark band covering middle third of wing and centering just distad of r-m crossvein, distal portion pale; broad bases of middle and hind femora pale (Fig. 15h) | <i>albitibia</i> Wirth          |
| – Wing with distal two-thirds dark; tibiae entirely and femora except extreme bases black (Fig. 15i)  | <i>smithii</i> (Coquillett)     |

12. *Probezzia albitibia* Wirth  
(Figs. 15h, 16a, 17a–d)

*Probezzia albitibia* Wirth, 1971:732 (male, female; Virginia; figs.).

*Female diagnosis*.—Wing length 2.5 mm. Head blackish; antenna with pedicel pale brown and segments 3–10 yellowish white; segments 11–15 dark brown. Palpus yellowish to brown. Thorax shining black. Legs (Fig. 15h) with coxae dark brown; trochanters and bases of femora yellow; front femur dark brown except at extreme base, distal half of middle femur and distal third of hind femur dark brown; front and middle tibiae yellowish white with faint basal and aipcal brown rings; hind tibia dark brown with pale brown sub-basal band and yellow subapical band; tarsi whitish, fifth tarsomers blackish. Wing whitish including veins; a prominent dark brown tranverse band across wing about a fourth as wide as wing is long, centering just past level of r-m crossvein and mediocubital fork, veins in this area dark brown, basal and distal pale areas of wing subequal in extent. Halter yellowish white. Abdomen pale, usually third to fifth terga blackish.

*Male*.—Similar to female but wing with dark band much fainter and

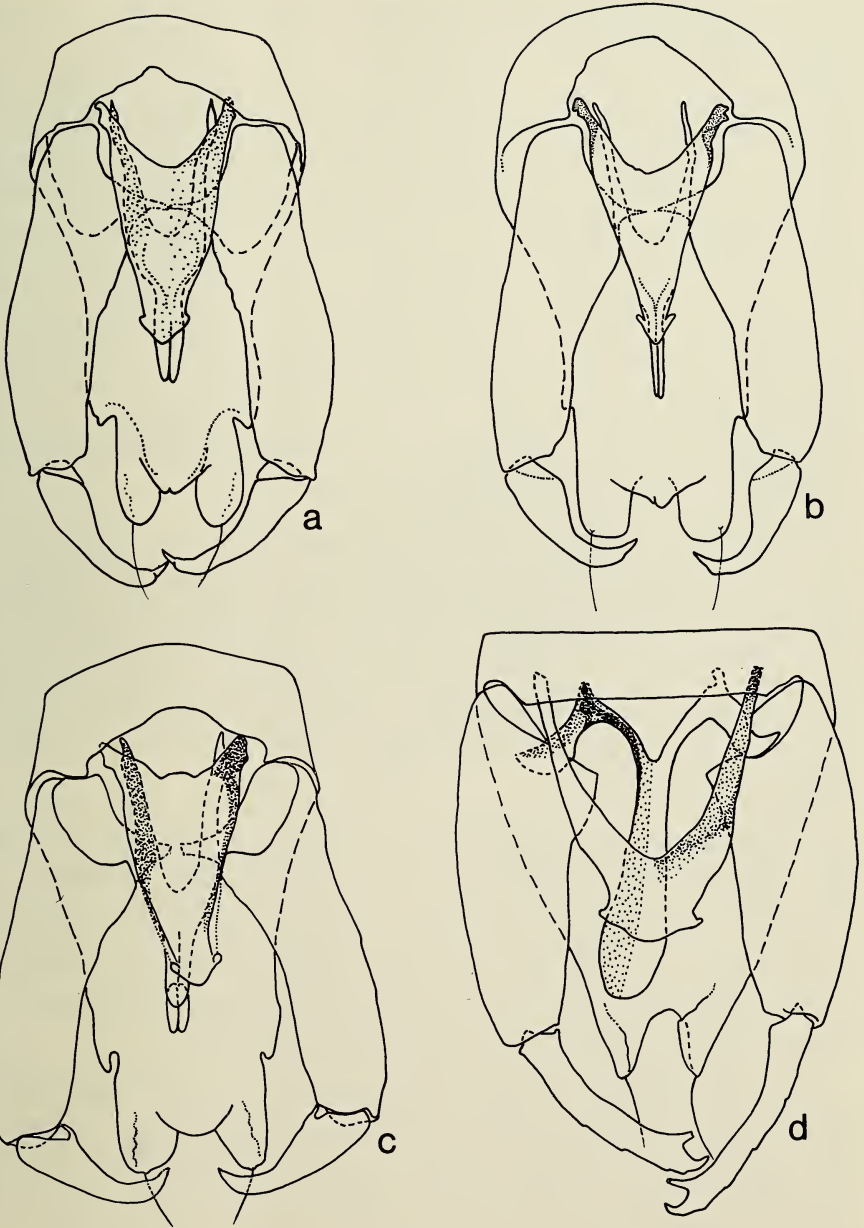


Fig. 16. *Probezzia* and *Sphaeromias* male genitalia: a, *P. albitibia*; b, *P. smithii*; c, *P. xanthogaster*; d, *S. bifidus*.

extending distally with decreasing intensity to wing tip; all tibiae infuscated except at extreme bases; abdomen pale at base, dark on distal half. Genitalia as in Fig. 16a.

*Immature stages.*—Larva unknown. Pupa with operculum (Fig. 17a) 1.3 times longer than broad, surface covered with small rounded tubercles as figured; anterior end pointed, posterior portion with two raised areas each with a pair of tubercles, the posterior one bearing a single long seta; posterior margin attached. Respiratory horn (Fig. 17b) four times longer than broad, surface smooth; apex with 4–8 spiracles. Female terminal segment (Fig. 17c) 1.3 times longer than broad; dorsum covered with small pointed tubercles as figured; venter covered with small pointed tubercles except for broad circular central area; apicolateral processes divergent, surface bare. Male terminal segment (Fig. 17d) 1.2 times longer than broad; dorsum and anterior fourth of venter covered with small pointed tubercles as figured; ventral genital processes short, appressed; apicolateral processes divergent, covered with scattered, small pointed tubercles.

*Distribution.*—Wisconsin to Quebec, south to Virginia.

*Potomac Valley records.*—D.C.: Washington, 14.vii.1924 (Malloch), 1 female. MARYLAND: Montgomery Co., Plummers Island, 11.vi (Barber), 1 female; 18.viii.1912 (Malloch), 1 female. Prince George's Co., Beltsville, Indian Creek, v.vi.1975 (Grogan, 1 female, 1 female, with pupal exuviae, reared from margin of a small, cold stream. VIRGINIA: Fairfax Co., Falls Church, Holmes Run, 2.vii.1961 (Wirth), 1 female; Potomac River at Scott Run, 4.7.vi.1955, reared from river margin (Wirth and Jones), 6 males, 3 females, with pupal exuviae.

*Biology.*—Wirth and Jones reared *P. albitibia* from the sandy margin of the Potomac River at the mouth of Scott Run, Fairfax County, Virginia, June 1955. Williams reared it from the beach at Douglas Lake, Michigan, July 1959. Wirth reared it from the edge of a sand bar in the Madawaska River in Algonquin Park, Ontario, June 1960; also from Fishing Brook, Hamilton Co., New York, June 1960, and from Dead Creek, Piercefild, St. Lawrence Co., New York, June 1963. Grogan reared this species from the margin of a small, cold stream (Indian Creek) at Beltsville, Maryland.

*Notes.*—The sexual dimorphism in leg markings in this species is unusual; in most species the leg markings are an important means of correlating males and females of the species. In the material of *albitibia* originally studied in 1971 it was noted that the series from Conewago Creek near York, Pennsylvania lacked the pale bands on the hind tibia; in the Potomac River series reared by Wirth and Jones some of the females also lacked these bands. The pupae were examined carefully but no characters were found to separate this series from typical *albitibia*, nor could other significant differences be found in females with these dark tibiae.



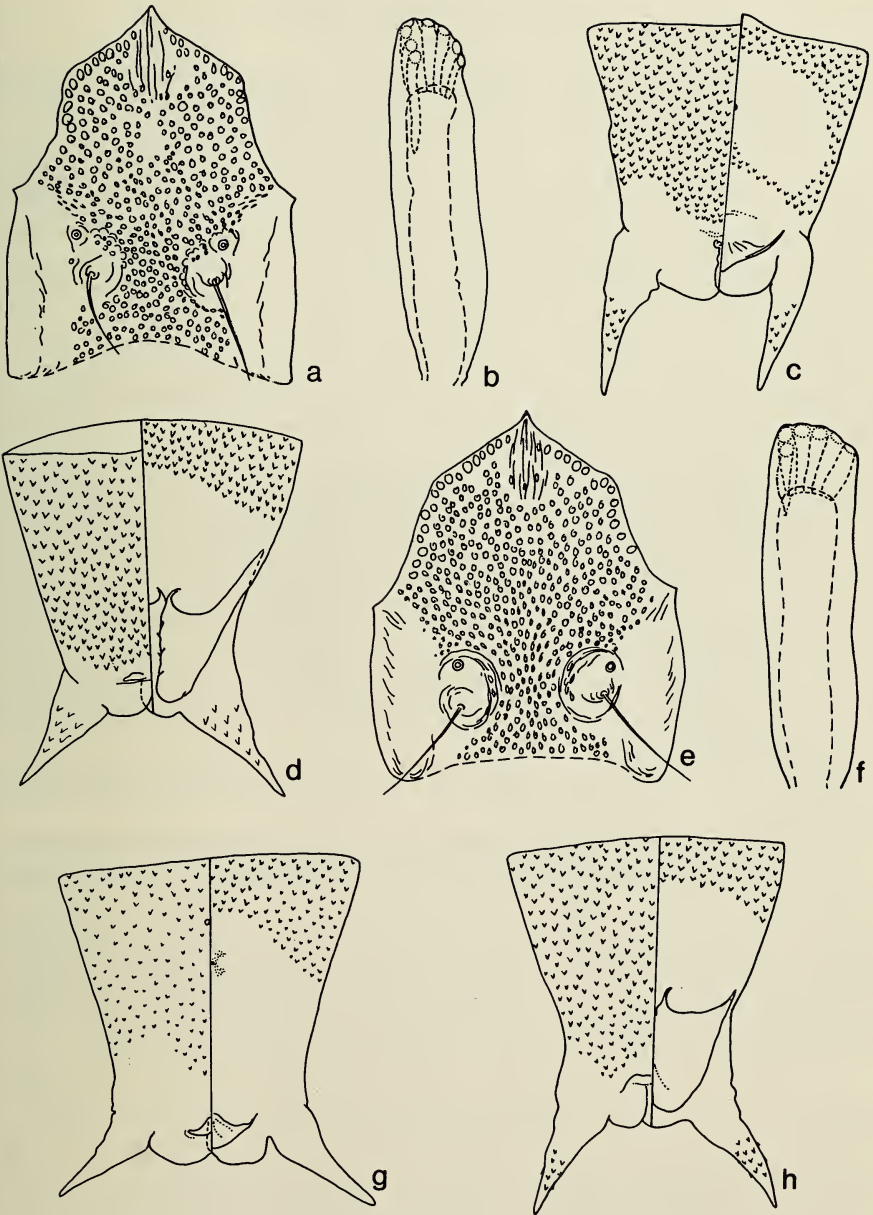


Fig. 17. *Probezzia* spp., pupa: a-d, *P. xanthogaster*; e-h, *P. pallida*; a, e, opercula; b, f, respiratory horns; c, g, female terminal segments; d, h, male terminal segments.

13. *Probezzia pallida* Malloch

(Fig. 15a-g; 17e-h)

*Probezzia pallida* Malloch, 1914:138 (female; Illinois); Wirth, 1951a:30 (distribution; notes); Wirth, 1971:736 (notes; distribution).

*Female diagnosis*.—Wing (Fig. 15a) length 2.8 mm. A medium-sized, uniformly pale yellowish species; head brown, antenna yellow with last five segments brownish; legs (Fig. 15g) pale, fifth tarsomeres black (Fig. 15f).

*Male*.—Differing markedly from the female in its shining black thorax and darkened abdomen, but easily recognized by its entirely pale legs (except for the black fifth tarsomeres). Genitalia as in Fig. 17f-g.

*Immature stages*.—Larva unknown. Pupa with operculum (Fig. 17e) 1.2 times longer than broad, surface covered with small, pointed tubercles as figured; anterior end pointed, posterior portion with raised area bearing two pairs of tubercles, the posterior pair bearing a single long seta; posterior margin attached. Respiratory horn (Fig. 17f) four times longer than broad, surface smooth; apex with 6-8 spiracles. Female terminal segment (Fig. 17g) 1.25 times longer than broad; dorsum and anterior third of venter covered with scattered small pointed tubercles as figured; apicolateral processes greatly divergent, surface bare. Male terminal segment (Fig. 17h) 1.35 times longer than broad; dorsum and anterior fourth of venter covered with small pointed tubercles; ventral genital processes short, greatly appressed; apicolateral processes moderately divergent, covered with scattered small pointed tubercles.

*Biology*.—This species has been reared numerous times from the margins of medium size to large streams.

*Distribution*.—North Dakota to Ontario, south to Arizona and Florida.

*Potomac Valley records*.—MARYLAND: Montgomery Co., Glen Echo, 12.vii.1922 (Malloch), 1 female; Plummers Island, 11.vi (Barber), 1 female. Prince George's Co., Beltsville, 23.vi.1918 (McAtee), 1 female. VIRGINIA: Fairfax Co., Falls Church, Holmes Run, 30.vii.1960, 1.vii.1961 (Wirth), 2 females; Potomac River at Scott Run, 4.7.vi.1955 (Wirth and Jones), reared from river margin), 1 male, 2 females, with pupal exuviae.

14. *Probezzia smithii* (Coquillett)

(Figs. 15i, 16b, 18a-c)

*Ceratopogon smithii* Coquillett, 1901:600 (female; New Jersey).

*Probezzia smithii* (Coquillett); Malloch, 1914:138 (combination); Wirth, 1951a:29 (notes; distribution); Wirth, 1971:737 (notes; distribution).

*Dicrobezzia smithii* (Coquillett); Johannsen, 1943:785 (combination; distribution).

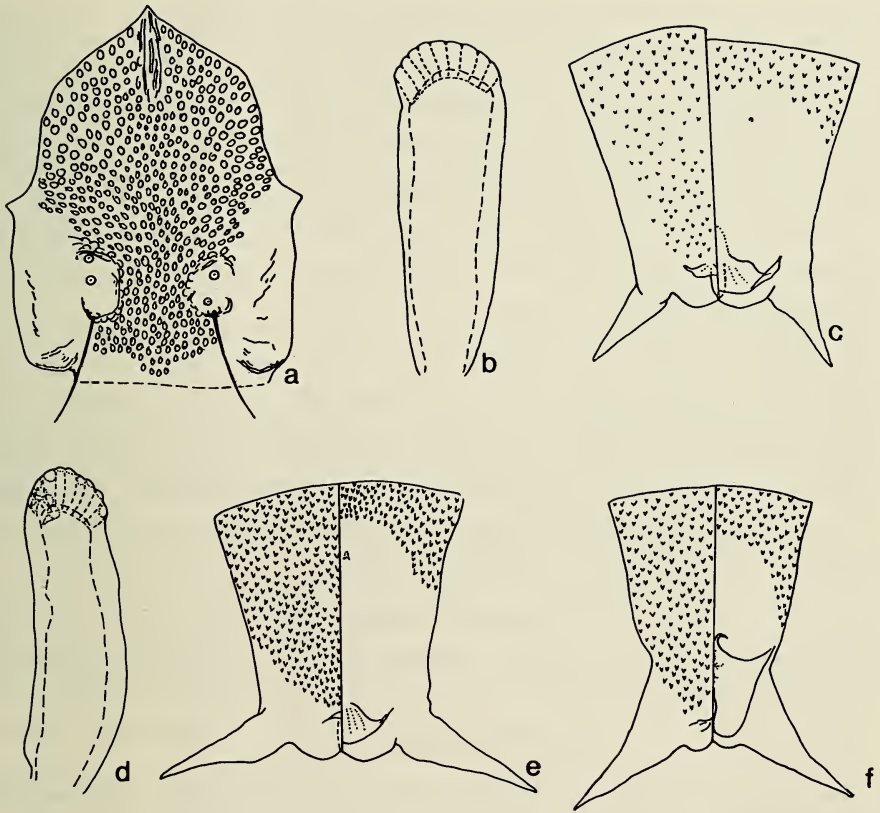


Fig. 18. *Probezzia* spp., pupa: a-c, *P. smithii*; d-f, *P. albitibia*; a, operculum; b, d, respiratory horns; c, e, female terminal segments; f, male terminal segment.

*Female diagnosis*.—Wing length 2.6 mm. A rather small black species; thorax and abdomen black; wing infuscated on distal two-thirds, the veins brown; halter whitish; antenna pale, last five segments brown; legs (Fig. 15i) black, except trochanters, extreme bases of femora and first four tarsomeres yellowish; abdomen usually extensively black dorsally.

*Male*.—Genitalia (Fig. 16b) with aedeagus wedge shaped, tapering distally to a narrow caplike tip, the forklike basal arch extending to about a fourth of total length; parameres with long, slender, anterior arms and distal tips in form of slender contiguous rods when viewed ventrally.

*Immature stages*.—Larva unknown. Pupa with operculum (Fig. 18a) 1.3 times longer than broad, surface covered with small rounded tubercles as figured; anterior end pointed; posterior portion with a pair of raised areas

with three pairs of tubercles, the posterior one bearing a single long seta; posterior margin attached. Respiratory horn (Fig. 18b) three times longer than broad, surface smooth; apex with 9–12 spiracles. Female terminal segment (Fig. 18c) 1.2 times longer than broad; dorsum covered with scattered small pointed tubercles; anterior fourth of venter covered with small pointed tubercles; apicolateral processes divergent, surface bare. Male terminal segment nearly identical with that of *P. xanthogaster* (Fig. 18f).

*Biology*.—This species has been reared twice from river margins; the Potomac River as noted below, and by Jones from the Wolf River in Wisconsin, June 1954.

*Distribution*.—Kansas and Wisconsin to New Jersey, south to Louisiana and Florida.

*Potomac Valley records*.—D.C.: Washington, 7.ix.1907 (McAtee), 1 female; 15.vii.1924 (Malloch), 1 female. MARYLAND: Montgomery Co., Plummers Island, 8.vi.1914 (Schwarz and Shannon), at light, 1 male. VIRGINIA: Fairfax Co., Chain Bridge, 20.viii.1922 (Malloch), 1 female; Potomac River at Scott Run, 4.vi.1955 (Wirth and Jones), reared from river margin, 4 males, 4 females, with pupal exuviae.

#### 15. *Probezzia xanthogaster* (Kieffer)

*Ceratopogon elegans* Coquillett, 1901:599 (female; New Jersey, preocc. Winnertz 1852).

*Bezzia* (*Probezzia*) *xanthogaster* Kieffer, 1917:329 (n. name for *elegans* Coquillett).

*Dicrobezzia xanthogaster* (Kieffer); Johannsen, 1943:785 (combination; distribution).

*Probezzia xanthogaster* (Kieffer); Wirth, 1951a:29 (combination; notes; distribution); Wirth, 1971:738 (notes; distribution).

*Female diagnosis*.—Wing length 2.5 mm. A rather small black and yellow species; thorax shining black; wing milky white including veins; halter white; antenna yellow, last five segment black; legs (Fig. 15j) yellow, coxae, distal third of all femora, extreme tip of hind tibiae, and fifth tarsomeres brownish black; abdomen yellowish (infuscation of front femur variable).

*Male*.—Genitalia (Fig. 16c) with aedeagus short with broad base, basal arch extending to less than a sixth of total length, and with slender caplike tip. Parameres with basal arms long and slender and placed closer together than usual, with distal tips stouter and more strongly bent in lateral view than usual.

*Immature stages*.—Larva unknown. Pupa with operculum nearly identical with that of *P. smithii* (Fig. 18a) except only two pairs of tubercles on

raised posterior portions, the posterior pair bearing a single seta. Respiratory horn (Fig. 18d) 3.5 times longer than broad, surface smooth; apex with 8–12 spiracles. Female terminal segment (Fig. 18e) 1.3 times broader than long; dorsum covered with small pointed tubercles; apicolateral processes greatly divergent, surface bare. Male terminal segment (Fig. 18f) 1.2 times longer than broad; dorsum covered with small pointed tubercles; anterior third of venter covered with small pointed tubercles; ventral processes short, greatly appressed; apicolateral processes moderately divergent, surface bare.

*Biology*.—This species has been reared from the margin of Quaker Run, Allegany State Park, New York (Wirth, May 1963); margin of Independence River, Glenfield, Lewis Co., New York (Wirth, June 1963); pond margin, Letchworth State Park, New York (Wirth, June 1963); river margin, Genessee River, Portageville, New York (Wirth, June 1963); creek margin, Taughannock Falls, Tompkins Co., New York (Wirth, June 1963); margin Wolf River, Outagamie Co., Wisconsin (Jones, June 1954); and margin Wisconsin River, Sauk Co., Wisconsin (Jones, June 1954).

*Distribution*.—Wisconsin to Ontario, south to Illinois and Virginia.

*Potomac Valley records*.—D.C.: Washington, v.1932 (Barber), 9 females. MARYLAND: Montgomery Co., Fairland, 10.vi.1958 (Hubert), 3 males; Plummers Island, 11.vi, 14.v.1914 (Shannon), 2 females. VIRGINIA: Alexandria, Dyke, 28.v.1915 (McAtee), 1 female. Fairfax Co., Holmes Run, Falls Church, 13.v, 10–14.vi.1961 (Wirth), 1 male, 3 females.

### Genus *Sphaeromias* Curtis

*Sphaeromias* Curtis, 1829: plate 285. Type-species, *Sphaeromias albomarginatus* Curtis, by original designation (synonym of *S. fasciatus* (Meigen)).

*Xylocrypta* Kieffer, 1899:69. Type-species, *Ceratopogon fasciatus* Meigen, by original designation.

*Diagnosis*.—Large, stout, grayish pollinose species. Femora with numerous small, sharp, ventral spines; fourth tarsomeres simple, not cordiform; fifth tarsomeres (Fig. 19c) armed ventrally with numerous long, black, blunt spines (batonnets); female claws (Fig. 19c) large, equal, curved, not as long as fifth tarsomere, each with slender, sharp tooth at base on inner side. Wing (Fig. 19a) with two radial cells; costa long, extending nearly to wing tip. Eighth segment of female abdomen without sclerotization or hair tufts; two large spermathecae present. Male aedeagus (Fig. 19d) with well developed basal arch and broad, caplike tip; parameres (Fig. 19e) joined in a V-shaped notch at base, fused distally in a long tongue-like lobe, tip usually setose.

*Immature stages*.—Larva described under *S. longipennis*. Larva of *S. pictus* (Meigen) (after Glukhova, 1977) with head rather short and ovoid,

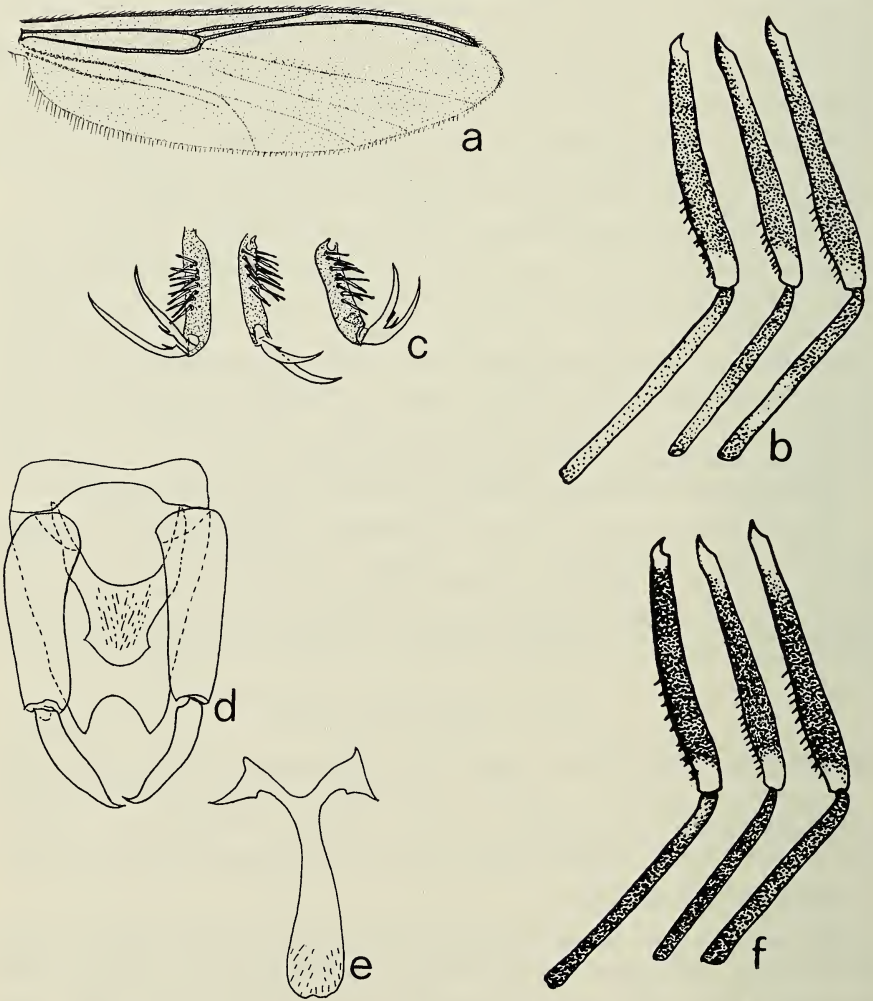


Fig. 19. *Sphaeromias* spp.: a-e, *S. longipennis*; f, *S. bifidus*; a, female wing; b, f, female leg patterns; c, female fifth tarsomere and claws; d, male genitalia, parameres removed; e, parameres.

slightly tapering, twice as long as broad; *o*, *s*, and *u* setae multiple; last segment with four pairs of short, slender, lateral setae and two minute pairs of perianal setae. Pupa (Fig. 20d) with respiratory horn elongate, tapering from broad, rounded apex; abdominal tubercles prominent, conical, and sharp-pointed; abdomen without ventral glandular discs.

*Biology*.—See discussion under *S. longipennis*.

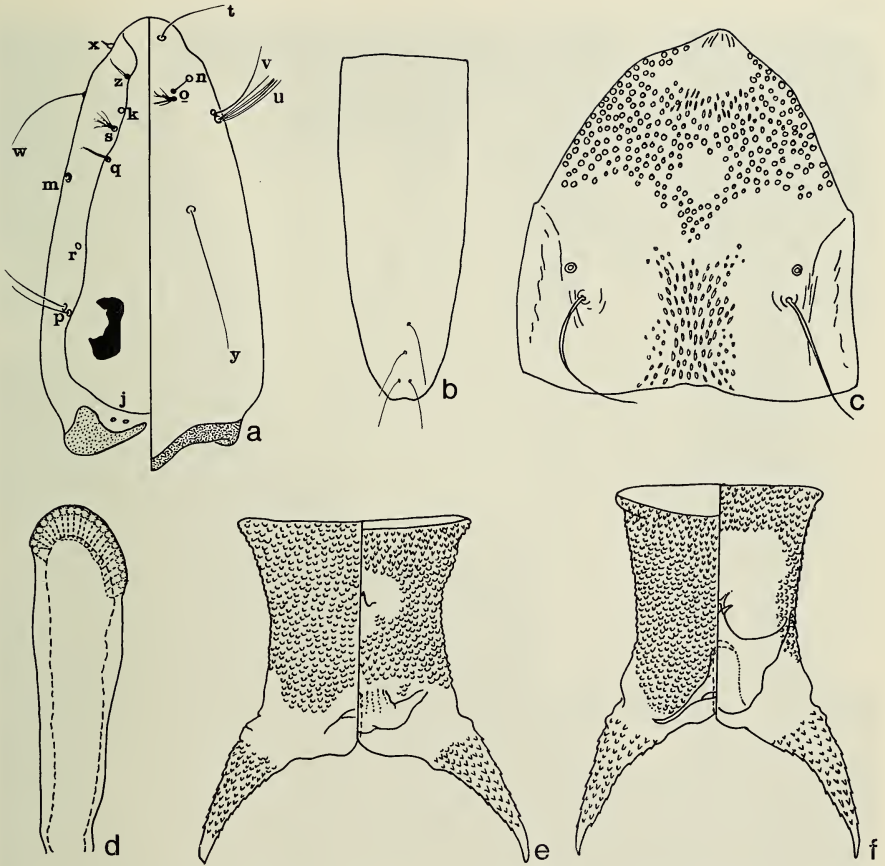


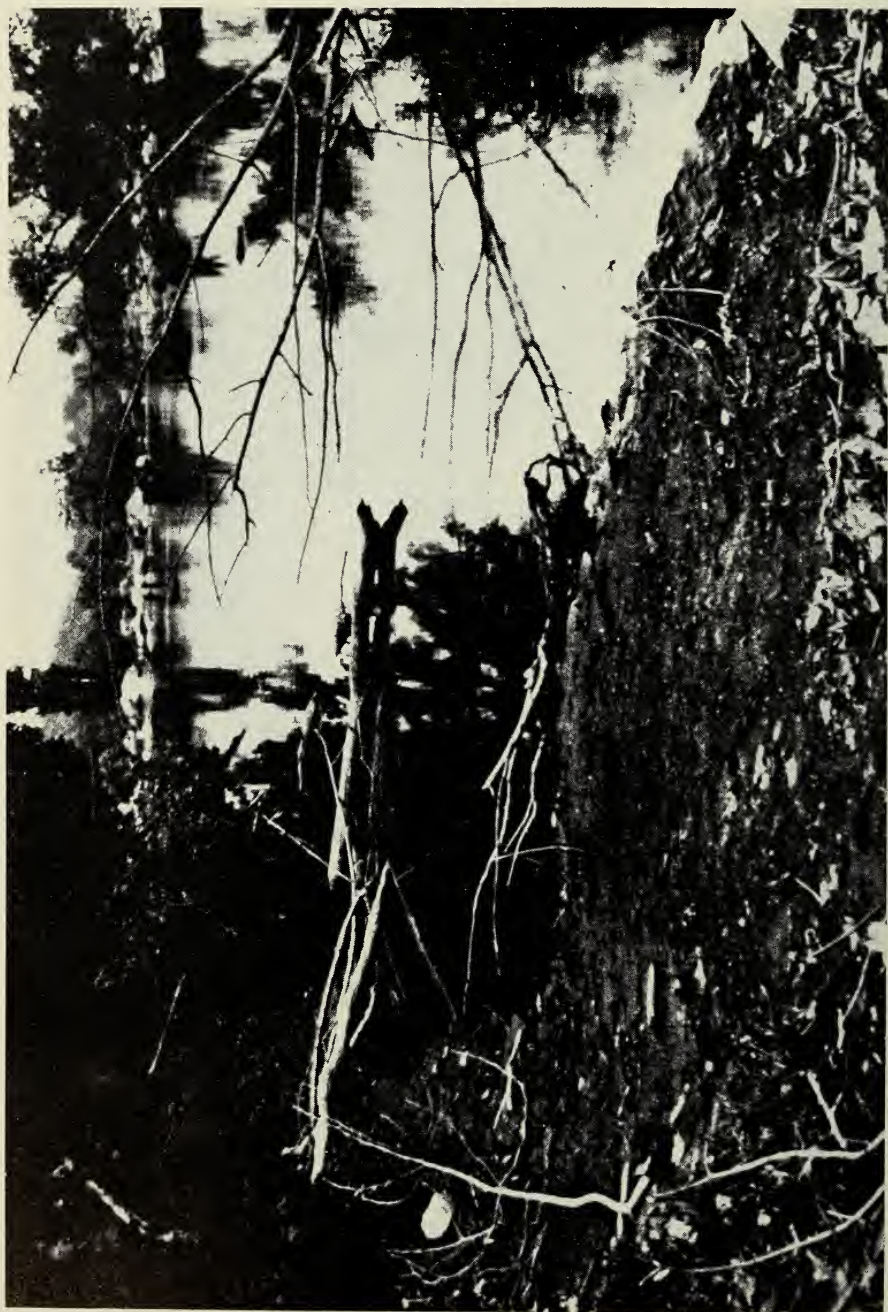
Fig. 20. *Sphaeromias longipennis*, a-b, larva; e-f, pupa: a, head capsule; b, terminal segment; c, operculum; d, respiratory horn; e, female terminal segment; f, male terminal segment.

Key to Potomac Valley Species of *Sphaeromias*

- 1. Tibiae of female entirely dark brownish black (Fig. 19f); male dististyle with bifurcate tip (Fig. 16d) *bifidus*, new species
- Female with front tibia and broad subapical bands on middle and hind tibiae light brown (Fig. 19b); male dististyle with pointed tip (Fig. 19d) *longipennis* (Loew)

*Sphaeromias bifidus* Wirth and Grogan, new species  
(Figs. 16d, 19f)

*Diagnosis.*—Closely resembling *S. longipennis* (Loew), but slightly smaller, female wing length 3.94 mm; differing also as follows: Dististyle of





male genitalia with bifurcate tip; female with tibiae entirely dark blackish brown.

*Allotype female*.—Wing length 3.94 mm, breadth 1.15 mm. Head brown. Antennal pedicel dark brown; proximal eight flagellomeres with proximal halves light brown; flagellomeres with lengths in proportion of 25-15-15-15-15-16-17-19-42-40-39-45-58; antennal ratio 1.64. Palpus slender; segments with lengths in proportion of 8-14-19-10-11; third segment lacking sensilla; palpal ratio 3.17. Mandible with seven large teeth on inner margin. Thorax dark brown. Legs (Fig. 19f) dark blackish brown; bases and apices of femora and base of front tibia paler brown; tarsomeres 1-3 yellowish; femora armed ventrally with spines on distal halves; fifth tarsomere as in *S. longipennis* (Fig. 19c), armed ventrally with several batonnets; claws equal and with inner basal barbs. Wing hyaline, similar to that of *S. longipennis* (Fig. 19; anterior veins light brown, posterior veins extremely pale; costal ratio 0.95. Halter stem pale, knob white. Abdomen dark brown. Spermathecae ovoid, subequal with very short necks.

*Holotype male*.—Similar to female but smaller; with the usual sexual differences; proximal eight flagellomeres light brown, plume brown; femora with bases only light brown, front tibia entirely dark; femora with fewer spines. Genitalia as in Fig. 16d. Ninth sternum 4.5 times broader than long, base nearly straight and a slight caudomedian excavation; ninth tergum with nearly straight base, tapering abruptly distally to a rounded tip, cerci short, extending slightly beyond basistyle. Basistyle curved slightly, 2.4 times longer than broad; dististyle 0.75 times the length of basistyle; slightly curved, tip bifurcate. Aedeagus 1.2 times longer than broad; basal arch 0.75 of total length, membrane spiculate; basal arm straight, heavily sclerotized proximally, distal portion lightly sclerotized, tip broadened. Parameres fused; basal arm heavily sclerotized, doubly recurved with an anterior projecting portion; distal portion more lightly sclerotized, slender proximally, broader distally with rounded tip covered with fine setae.

*Etymology*.—The specific name *bifidus*, Latin for two-branched, refers to the distinctive bifurcate dististyle on the male genitalia.

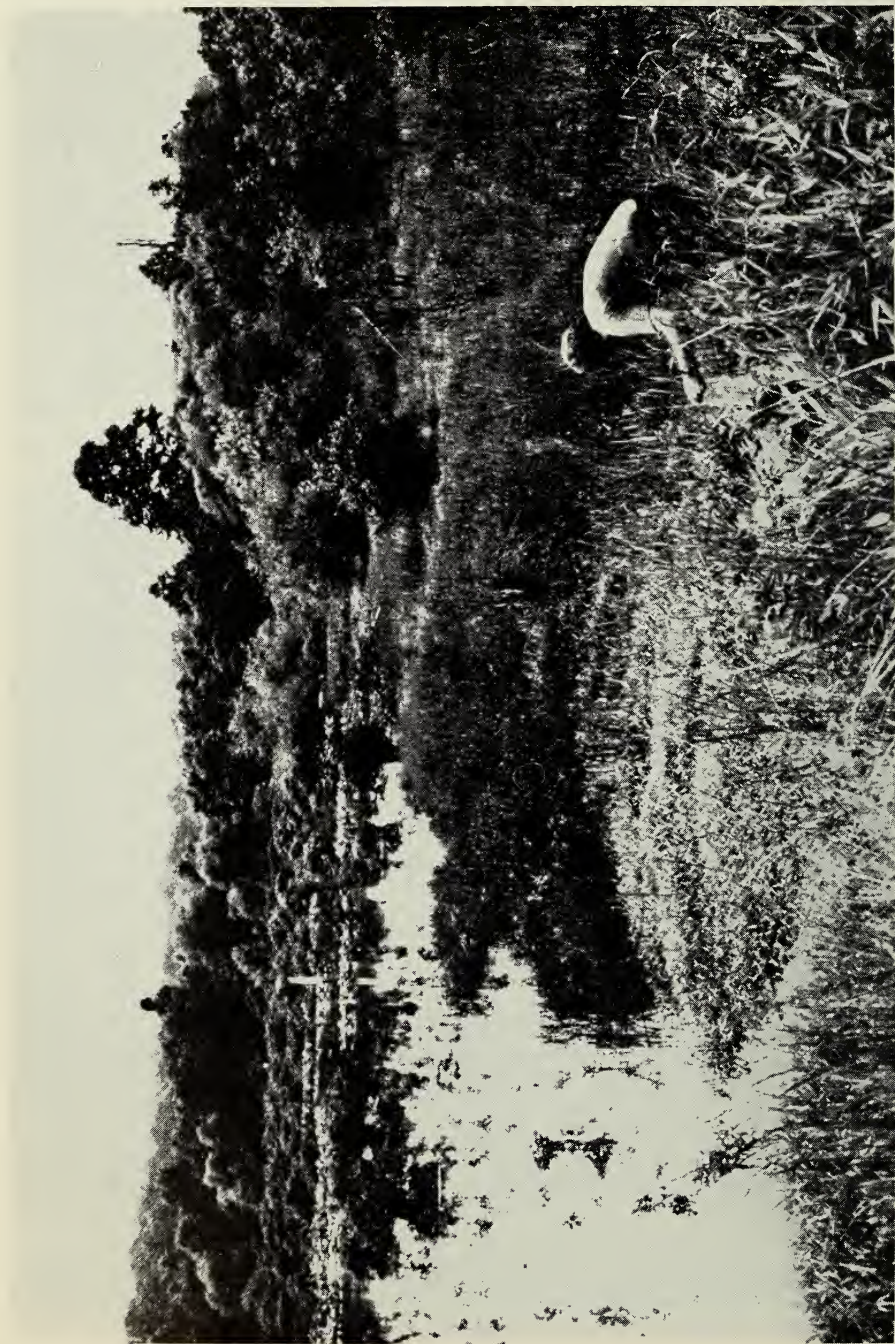
*Distribution*.—Maryland; presently known only from the type locality.

*Types*.—Holotype, male, allotype, female, Patuxent Wildlife Research Center, Prince George's Co., Maryland, male 14-17 June, female 6-11 July, 1976, W. L. Grogan, Jr., malaise trap (Type no. 71,176, USNM).

*Discussion*.—*Sphaeromias longipennis* differs from *bifidus* as follows: male genitalia with pointed tip on dististyle and basal arch of aedeagus 0.6

←

Fig. 21. Sandy margin of Potomac River at the lower end of Plummers Island, a characteristic habitat of the stream-dwelling *Sphaeromiini*.



times length of aedeagus; females larger (wing length 4.2–4.9 mm), with front tibia and broad subapical bands on middle and hind tibiae pale brown.

*Biology*.—The two specimens of this unusual species were taken in a malaise trap from a swampy situation (Fig. 23) near stagnant water where sphagnum, skunk cabbage, and *Osmunda* ferns were plentiful and red maples and sweet gum are the predominant trees. It is likely that *S. bifidus* prefers such swampy situations whereas *S. longipennis* is normally found in open bodies of water such as ponds, lakes and streams. However, there is the possibility that these two species may occur together as two males of *S. longipennis* were taken in the malaise trap at the same site. These may have strayed from a nearby pond (Knowles Marsh no. 1) which contained large quantities of algae and other aquatic vegetation, the usual habitat of *S. longipennis* larvae. A female of *S. longipennis* was reared from this pond, thus lending further proof of this hypothesis.

The discovery of a new species of *Sphaeromyias* in North America was entirely unexpected. It is more remarkable in view of the fact that Wirth (1962a) recently reviewed *S. longipennis* and reported it from most of North America. This species is usually extremely abundant wherever it is found and it inhabits a wide variety of aquatic habitats. At present it is impossible to determine the distribution of *S. bifidus*. However, it is likely that it may be chiefly an inhabitant of the southeastern Coastal Plain, an area poorly represented by ceratopogonids in the U.S. National Museum.

*Sphaeromyias longipennis* (Loew)  
(Figs. 19a–e, 20)

*Ceratopogon longipennis* Loew, 1861:313 (female; Pennsylvania).

*Palpomyia* (*Sphaeromyias*) *longipennis* (Loew); Kieffer, 1906:62 (combination).

*Palpomyia longipennis* (Loew); Malloch, 1914:219 (male, female, larva, pupa; habits; figs.; Illinois); Malloch, 1915a:323 (larva; figs.; habits; Illinois); Kieffer, 1917:319 (in key); Thomsen, 1935:295 (fig. male genitalia); Thomsen, 1937:75 (larva, pupa; figs.; New York).

*Homohelea longipennis* (Loew); Kieffer, 1917:364 (combination).

*Sphaeromyias longipennis* (Loew); Johannsen, 1943:784 (combination, distribution); Wirth, 1952:214 (redescribed; California; distribution; figs.); Wirth, 1962a:278 (redescribed; figs.; distribution).

*Female diagnosis*.—A large robust species; wing length 4.2–4.9 mm.

←

Fig. 22. Margin of Knowles Marsh no. 1 in floodplain of Patuxent River, Patuxent Wildlife Research Center, Prince George's County, Maryland.



Thorax dull grayish brown, mesonotum heavily overlaid with whitish pollen, also with sparse, erect, short, sharp spinules. Legs (Fig. 19b) yellowish, front femur with broad midportion and middle and hind femora with broad subapical bands blackish; tibiae with broad sub-basal bands and narrow apices black; narrow tips of tarsomeres 1-4 and all of fifth blackish. Wing and halter whitish. Abdomen densely whitish pollinose above. Legs with abundant sharp spines ventrally on femora, front and hind femora especially somewhat arcuate and swollen on distal portion.

*Male*.—As in the female with usual sexual differences; legs dark brown except bases of femora and four proximal tarsomeres pale. Male genitalia as in Fig. 19d, e.

*Immature stages*.—Larva (fourth instar) 15-17 mm long. Head capsule (Fig. 20a) twice as long as broad; eye kidney shaped, located mesad of epicranial suture; dorsum with chaetotaxy as follows: two pairs of small *j* pits just anterior to postoccipital ridge; two pairs of *p* setae opposite eye spot; *r* pit anterior to eye; *q* seta mesad of epicranial suture; *m* pit on lateral margin just posterior to *q* seta; *s* seta just anterior to *q* seta laterad of epicranial suture; *z* seta anterior to *k* pit; *w* seta on lateral margin nearly opposite *z* seta; *x* seta short. Venter of head with chaetotaxy as follows: *y* seta about halfway between *m* and *r* pits; *o* seta multiple; single *v* seta opposite *k* pit; *u* seta multiple, anterad of *k* pit; *t* seta single. Terminal segment (Fig. 20b) 2.6 times longer than broad; posterior end with four pairs of short, slender setae.

*Pupa*.—Operculum (Fig. 20c) slightly longer than broad; anterior margin slightly pointed, surface covered with small rounded tubercles as figured; central area with slightly elevated portions each bearing a single long seta and a pit just anterad of the seta; posterior margin slightly convex. Respiratory horn (Fig. 20d) 3.5 times longer than broad, surface smooth; apex with 20-30 spiracles. Female terminal segment (Fig. 20e) slightly longer than broad; dorsum covered with small pointed tubercles; venter covered with small pointed tubercles except for circular central portion; apicolateral processes moderately divergent, covered with small pointed tubercles. Male terminal segment (Fig. 20f) 1.3 times longer than broad; dorsum covered with small pointed tubercles; anterior fourth and lateral margins of venter covered with small pointed tubercles, genital processes short, greatly appressed; apicolateral processes covered with short pointed tubercles.

*Biology*.—Malloch (1914, 1915a) described all stages of *S. longipennis* from Illinois. He stated that the eggs are laid in groups on the leaves of

---

←

Fig. 23. Malaise trap site in swamp adjacent to Knowles Marsh no. 1, Patuxent Wildlife Research Center, Prince George's County, Maryland.

plants in the water and covered with a gelatinous substance. The larvae were found in the Illinois River and in a nearby lake often submerged to a depth of as much as 8.5 ft. The pupae kept in rearing vials did not entirely leave the water as did related genera, but remained with the posterior half of the body submerged in the water. Thomsen (1937) found the larvae and pupae of *S. longipennis* in great numbers in blanket algae in Goodell Lake, New York. Wirth reared it from mud and sand at the margin of the Rideau River in Ottawa, Ontario, on 29 May 1960, where it was associated with *Jenkinshelea albaria*, *Johannsenomyia argentata*, *Probezzia pallida*, *Mallochohelea albihalter* Wirth and *M. smithi* (Lewis), and species of *Stilobezzia* and *Bezzia*. Grogan recovered larvae and pupae from debris along the margin of Black Lake, Ontario. Larvae were very active when placed in water and swam with just their head at the surface, the remainder of their body extending at an oblique angle into the water. Our larval and pupal descriptions are based on this material.

*Distribution.*—Minnesota to Ontario, south to Texas and Florida, also California.

*Potomac Valley records.*—D.C.: Washington, 30.vii.1907 (McAtee), 1 female; 15.vii.1914 (McAtee), 1 female. MARYLAND: Montgomery Co., Colesville, 17.vi.1975 (Wirth), 1 female; Potomac, 17.vii.1976 (Steiner), 1 female. Prince George's Co., Patuxent Wildlife Research Center, 17.v.1976 (Grogan), 1 female, reared; 1.vii.1976 (Grogan), 2 males, malaise trap. VIRGINIA: Alexandria, Dyke Marsh, 19.vi, 6.vii.1952 (Wirth), 3 males.

## VI. Acknowledgments

We gratefully acknowledge support of this project in the form of a research grant from the Washington Biologists Field Club. The junior author carried on the field work with financial support from this grant during the summer of 1976 and Shahin Navai received grant support for field work during the summer of 1977.

For permission to collect in the Chesapeake and Ohio National Historical Park we wish to thank William R. Failor, Superintendent. We thank William H. Stickel, U.S. Fish and Wildlife Service, Laurel, Maryland, for permission to collect in the Patuxent Wildlife Research Center and for much helpful advice and guidance. We are grateful to J. Antony Downes of Agriculture Canada, Ottawa, for the photograph used in Fig. 1. We also are grateful to Ethel L. Grogan and Niphan C. Ratanaworabhan for assistance with the illustrations, and to Warren E. Steiner for the photographs in Figs. 21 to 23.

## Literature Cited

- Coquillett, D. W. 1895. Descriptions of new genera and species. pp. 307-319, In: C. W. Johnson, *Diptera of Florida*. Proc. Acad. Nat. Sci. Philadelphia, 1895:303-340.

- . 1901. New Diptera in the U.S. National Museum. Proc. U.S. Nat. Mus. 23: 593–618.
- . 1902. New Diptera from North America. Proc. U.S. Nat. Mus. 25:83–126.
- . 1905. New nematoceros Diptera from North America. Jour. New York Ent. Soc. 13:56–69.
- . 1910. The type species of the North American genera of Diptera. Proc. U.S. Nat. Mus. 37:499–647.
- Curtis, J. 1829. British Entomology. Vol. 7: plates 195–241.
- Debenham, M. L. 1974. A revision of the Australian and New Guinea predatory Ceratopogonidae (Diptera: Nematocera) of the tribes Heteromyiini and Sphaeromyiini. Australian Jour. Zool. Suppl. Ser. 28:1–92.
- Dendy, J. S. 1973. Predation on chironomid eggs and larvae by *Nanocladius alternantherae* Dendy and Sublette (Diptera: Chironomidae), Orthoclaadiinae. Ent. News 84:91–95.
- Downes, J. A. 1960. Feeding and mating, and their interrelationship in the insectivorous Ceratopogoninae (Diptera). Verh. XI Int. Kongr. Ent. Wien 1960 1:618.
- . 1971. The ecology of blood-sucking Diptera: an evolutionary perspective. pp. 232–258, In: A. M. Fallis, ed. Ecology and Physiology of Parasites: A Symposium. Univ. Toronto Press.
- . 1978. Feeding and mating in the insectivorous Ceratopogoninae (Diptera). Mem. Ent. Soc. Canada 104:1–62.
- Duret, J. P., and J. Lane. 1955. Novas *Heteromyia* da Argentina (Diptera, Ceratopogonidae). Dusenía 5:35–40.
- Edwards, F. W. 1920. Some records of predaceous Ceratopogoninae (Diptera). Ent. Mo. Mag. Ser. 3, 6:203–205.
- . 1923. New and old observations on ceratopogonine midges attacking other insects. Ann. Trop. Med. Parasit. 17:19–29.
- Gad, A. M. 1951. The head-capsule and mouth-parts in the Ceratopogonidae (Diptera: Nematocera). Bull. Soc. Fouad Ier Ent. 35:17–75.
- Glukhova, V. M. 1971. Descriptions of the larvae of some non-bloodsucking midges of the family Ceratopogonidae (Diptera). (In Russian). Ent. Obozr. 50:171–182 (translation in Rev. Ent. 50:99–105).
- . 1977. Biting midges. Ceratopogonidae (Heleidae). pp. 431–457, In: L. A. Kutikova and Ya. I. Starabokatov, eds. Determination of the Freshwater Invertebrates of the European Parts of the USSR (Plankton and Benthos). (In Russian). Leningrad. 510 pp.
- Grogan, W. L., Jr., and W. W. Wirth. 1975. A revision of the Nearctic species of *Climohelea* Kieffer (Diptera: Ceratopogonidae). Great Basin Nat. 35:275–287.
- . 1977. A revision of the Nearctic species of *Jenkinshelea* Macfie (Diptera: Ceratopogonidae). Proc. Ent. Soc. Washington 79:126–141.
- Hamm, A. H. 1919. A ribbon-making fly: the oviposition of *Ceratopogon nitidus* Macq. Ent. Mon. Mag. 5:66–67.
- Johannsen, O. A. 1905. Aquatic Nematoceros Diptera II. pp. 76–315, pls. 16–37, In: J. G. Needham, K. J. Morton, and O. A. Johannsen. May flies and midges of New York. Third report on aquatic insects. N.Y. St. Mus. Bull. 86:7–352, 37 plates.
- . 1943. A generic synopsis of the Ceratopogonidae (Heleidae) of the Americas, a bibliography, and a list of the North American species. Ann. Ent. Soc. Amer. 36:763–791, 3 plates.
- . 1952. A guide to the insects of Connecticut. Part VI. The Diptera or true flies of Connecticut. Fifth fascicle: Midges and gnats. Family Heleidae

- (= Ceratopogonidae). Connecticut St. Geol. and Nat. Hist. Survey Bull. 80: 149-175, 232-250, plates 1-3.
- Kieffer, J. J. 1899. Description d'un nouveau genre et tableau des genres européens de la famille des Chironomides (Dipt.). Bull. Soc. Ent. France 1899:66-70.
- . 1906. Diptera. Fam. Chironomidae. Fasc. 42, 78 pp., 4 plates. In: P. Wytzman, ed. Genera Insectorum. Bruxelles.
- . 1913. Nouvelle étude sur les Chironomides de l'Indian Museum de Calcutta. Rec. Indian Mus. 9:119-197, 2 plates.
- . 1917. Chironomides d'Amérique conservés au Musée National Hongrois de Budapest. Budapest Magyar Nemzeti Muz. Ann. Hist. Nat. 15:292-364.
- . 1919. Chironomides d'Europe conservés au Musée National Hongrois de Budapest. Budapest Magyar Nemzeti Muz. Ann. Hist. 17:1-160.
- . 1925. Diptères (Nématocères piqueurs): Chironomidae Ceratopogoninae. Vol. 11, 139 pp., In: Faune de France, Paris.
- Krivosheina, N. P. 1957. Habitat of larvae and pupae of Heleidae (in Russian). Moscow Univ. Vest. Ser. Biol. Pochvoved. Geol. 2:67-73.
- Loew, H. 1861. Diptera Americae septentrionalis indigena. Centuria Prima. Berlin Ent. Ztschr. 5:307-359.
- . 1864. Ueber die in der zweite Hälfte des Juli 1864 auf der Ziegelwiese bei Halle beobachteten Dipteren. Ztschr. Gesam. Naturw. Halle no. xi: 377-396.
- Malloch, J. R. 1914. Notes on North American Diptera, with descriptions of new species in the collection of the Illinois State Laboratory of Natural History. Bull. Illinois State Lab. Nat. Hist. 10:213-243, 3 plates.
- . 1915a. The Chironomidae, or midges, of Illinois, with particular reference to the species occurring in the Illinois River. Bull. Illinois State Lab. Nat. Hist. 10:275-543, 24 plates.
- . 1915b. Some additional records of Chironomidae for Illinois and notes on other Illinois Diptera. Bull. Illinois State Lab. Nat. Hist. 11:305-363, 5 plates.
- Say, T. 1825. American Entomology, or Descriptions of the Insects of North America. Vol. 2, 121 pp., pls. 19-36.
- Staeger, R. C. 1839. Systematisk fortegnelse over de i Danmark hidtil fundne Diptera. Naturhist. Tidsskr. 2:549-600.
- Thomsen, L. C. 1935. New species of New York State Ceratopogonidae. Jour. New York Ent. Soc. 43:283-296, 2 plates.
- . 1937. Part V. Ceratopogonidae. pp. 57-80, plates 10-18. In: O. A. Johannsen and L. C. Thomsen, Aquatic Ciptera. Parts IV and V. Cornell Agr. Expt. Sta. Mem. 210:1-80, 18 plates.
- Walker, F. 1856a. Diptera. Vol. 1, pp. 415-474. In: W. W. Saunders, ed. Insecta Saundersiana. London.
- . 1856b. Insecta Britannica. Diptera. Vol. III. 352 pp., 10 plates. London.
- Weerekoon, A. C. J. 1953. On the behaviour of certain Ceratopogonidae (Diptera). Proc. R. Ent. Soc. London 28:85-92.
- Wesenberg-Lund, C. 1943. Biologie der Susswasserinsekten. 682 pp. Copenhagen.
- Williams, R. W. 1955. Observations on some Heleidae (Diptera) of the psammolittoral zone of Douglas Lake, Michigan. Ent. News 66:93-97.
- Wirth, W. W. 1951a. The genus *Probezzia* in North America (Diptera, Heleidae) Proc. Ent. Soc. Washington 53:25-34.
- . 1951b. New species and records of Virginia Heleidae (Diptera). Proc. Ent. Soc. Washington 53:313-326, 1 plate.
- . 1952. The Heleidae of California. Univ. California Pubs. Ent. 9:95-266.



- . 1962a. A reclassification of the *Palpomyia-Bezzia-Macropeza* groups, and a revision of the North American Sphaeromiini (Diptera, Ceratopogonidae). *Ann. Ent. Soc. Amer.* 55:272-287.
- . 1962b. The North American species of the biting midge genus *Jenkinshelea* Macfie (Diptera: Ceratopogonidae). *Bull. Brooklyn Ent. Soc.* 57:1-4.
- . 1965. Family Ceratopogonidae (Heleidae). pp. 121-142. In: A. Stone, et al. A catalog of the Diptera of America north of Mexico. U.S. Dept. Agr. Handbook 276, 1696 pp.
- . 1971. Six new North American species of *Probezzia* (Diptera: Ceratopogonidae), with biological notes and a key to species. *Ann. Ent. Soc. Amer.* 64: 729-739.
- Wirth, W. W., and W. L. Grogan, Jr. 1977. Taxonomic notes on the genus *Heteromyia* Say, and a new species from Nicaragua (Diptera: Ceratopogonidae). *Florida Ent.* 60:177-185.
- Wirth, W. W., N. C. Ratanaworabhan, and F. S. Blanton. 1974. Synopsis of the genera of Ceratopogonidae (Diptera). *Anns. Parasit. Hum. Comp.* 49:595-613.
- Wirth, W. W., N. C. Ratanaworabhan, and D. H. Messersmith. 1977. Natural History of Plummers Island, Maryland. XXII. Biting midges (Diptera: Ceratopogonidae). 1. Introduction and key to genera. *Proc. Biol. Soc. Washington* 90:615-647.

(WWW) Systematic Entomology Laboratory, IIBIII, Federal Research, Sci. & Admin. Admin., c/o U.S. National Museum, Washington, D.C. 20560;  
(WLG) Department of Entomology, University of Maryland, College Park, Maryland 20742.